BRITISH COLUMBIA
MINISTRY OF FORESTS

Arrow
Timber Supply Area

Rationale for
Allowable Annual Cut (AAC)
Determination

Effective July 1, 2005

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106-04834/

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Objective of this Document

This document is intended to provide an accounting of the factors I have considered and the rationale I have employed as chief forester of British Columbia (BC) in making my determination, under Section 8 of the *Forest Act*, of the allowable annual cut (AAC) for the Arrow timber supply area (TSA). This document also identifies where new or better information is needed for incorporation in future determinations.

Description of the Arrow Timber Supply Area

The Arrow TSA, approximately 605 640 hectares in total area, is administered from the BC Forest Service (BCFS) Arrow Boundary District office in Castlegar. The Arrow TSA is one of fifteen TSAs lying within the Southern Interior Forest Region of BC. Although not part of the Arrow TSA, two Tree Farm Licences and several parks lie within the outer perimeter of the TSA ("TSA region").

Approximately 43 700 people reside in the TSA region based on a 2001 census. About 40% of the population resides in the three major communities of Castlegar, Trail and Rossland with a combined population of about 18 200. Other communities include Fruitvale, Montrose, Warfield, Salmo, Slocan, Silverton, New Denver and Nakusp. The public sector, forestry and tourism account for over 60% of the total employment in the Arrow Boundary Forest District with forestry at 20%.

No First Nations communities are located within the TSA, although the Ktunaxa Kinbasket, Shuswap and Okanagan Nations have asserted traditional territories within the Arrow TSA.

Numerous natural resources occur within the Arrow TSA. These include timber, fish and wildlife habitat, recreation and tourism resources, and abundant water resources. Approximately 47 percent of the area considered available for harvesting is located within watersheds licensed for consumptive use.

Forests in the Arrow TSA are among the most productive and diverse in the interior of the province. Predominate tree species at lower elevations are Douglas-fir, lodgepole pine, western larch, western hemlock and western red cedar, and at higher elevations they are subalpine fir and Engelmann spruce. White pine, ponderosa pine, grand fir, aspen, black cottonwood and paper birch are also common in the TSA.

The Arrow TSA supports a diversity of fish and wildlife species. For example, nearly all the ungulate species present in BC, including bighorn sheep, white-tailed and mule deer, moose, mountain goats, elk and caribou are found in the TSA.

History of the AAC

In 1981, the AAC for the Arrow TSA was determined to be 640 000 cubic metres. In 1983, the AAC was reduced to 619 000 cubic metres to reflect the creation of Valhalla Provincial Park and this AAC level was maintained in the 1995 determination. The 2001 AAC determination reduced the AAC to 550 000 cubic metres. The Minister of Forests currently apportions the AAC as follows:

Apportionment	Cubic metres per year	Percentage
Replaceable Forest Licences	447 268	81.32
BC Timber Sales	99 208	18.04
Forest Service Reserve	3 524	0.64
Total	**550 000**	**100.0**

New AAC determination

Effective July 1, 2005, the new AAC for the Arrow TSA will be 550 000 cubic metres, which maintains the current AAC. This volume excludes all volumes allocated to woodlot licences. This AAC will remain in effect until a new AAC is determined, which must take place within five years of the present determination unless a postponement is authorized. (Please note the possibility of an earlier redetermination, discussed below in 'Reasons for Decision.').

Information sources used in the AAC determination

Under the Defined Forest Area Management (DFAM) initiative, DFAM participants were collectively responsible for completing the Arrow TSA timber supply analysis. DFAM participants in the TSA were called the Arrow Forest Licence Group. The Group hired Timberline Forest Inventory Consultants Ltd to undertake the 2004 timber supply analysis including supporting documents.

The information sources used in this determination include but are not limited to:

- *Arrow Timber Supply Area Analysis Report,* June 2004;
- *Arrow Timber Supply Area Analysis Report, Socio-Economic Assessment,* June 2004;
- *Arrow Timber Supply Area Analysis Report, Data Package,* June 2004;
- *Arrow Timber Supply Area Analysis Report, Public and First Nations Review Report,* June 2004 and subsequent submissions from First Nations;
- *Arrow Timber Supply Area, Feedback Documentation,* June 2004;
- *Arrow TSA Rationale for AAC determination effective April 30, 2001*;
- *Arrow TSA Analysis Report,* BCFS, April 2000;
- *Kootenay-Boundary Higher Level Plan Order*, October 26, 2002, and variances;
- Arrow TSA Vegetation Resource Inventory (VRI), Ministry of Sustainable Resource Management (MSRM), completed in 2002 with updates to August 2003;
- Biogeoclimatic Ecosystem Classification, BCFS Research Branch, update, 1999;
- Letter from the Minister of Forests to the chief forester, dated July 28, 1994, stating the Crown's economic and social objectives for the province;

- Memorandum from the Minister of Forests to the chief forester, dated February 26, 1996, stating the Crown's economic and social objectives for the province regarding visual resources;
- Letter from the Deputy Ministers of Forests and (then) Environment, Lands and Parks, (MELP) dated August 25, 1997, conveying government's objectives regarding the achievement of acceptable impacts on timber supply from biodiversity management;
- *Forest and Range Practices Act*, 2002 and amendments;
- *Forest and Range Practices Regulations,* 2004 and amendments;
- *Forest Practices Code of British Columbia Act*, 1995, and amendments;
- *Forest Practices Code of British Columbia Act Regulations,* 1995, and amendments;
- *Forest Practices Code of British Columbia* Guidebooks, BCFS and MELP;
- *Biodiversity Guidebook*, Province of British Columbia (BC), September 1995;
- *Landscape Unit Planning Guide*, Province of BC, 1999;
- *Riparian Management Area Guidebook*, Province of BC, December 1995;
- Technical review and evaluation of current operating conditions through comprehensive discussions with BCFS and Ministry of Water, Land and Air Protection (MWLAP) staff, including the AAC determination meeting held in Castlegar, February 21-23, 2005 and a helicopter review of portions of the TSA on February 22, 2005 with district staff.

Role and limitations of the technical information used

Section 8 of the *Forest Act* requires the chief forester, in determining AACs, to consider biophysical, social and economic information. Most of the technical information used in determinations is in the form of a timber supply analysis and its inputs of inventory and growth and yield data. These are concerned primarily with biophysical factors—such as the rate of timber growth and the definition of the land base considered available for timber harvesting—and with management practices.

The computerised analytical models currently used to assess timber supply unavoidably simplify the real world and also involve uncertainty in many of the inputs, due in part to variations in physical, biological and social conditions. While ongoing science-based improvements in the understanding of ecological dynamics will help reduce some of these uncertainties, technical information and analytical methods alone cannot incorporate all the social, cultural and economic factors relevant to forest management decisions, nor do they necessarily provide complete answers or solutions to the forest management problems addressed in AAC determinations. However, they do provide valuable insight into potential outcomes of different resource-use assumptions and actions—important components of the information that must be considered in AAC determinations.

In determining the AAC for the Arrow TSA I have considered and discussed known limitations of the technical information provided, and I am satisfied that the information provides a suitable basis for my determination.

Statutory framework

Section 8 of the *Forest Act* requires the chief forester to consider a number of specified factors in determining AACs for timber supply areas and tree farm licences. Section 8 is reproduced in full as Appendix 1 of this document.

Guiding principles for AAC determinations

Rapid changes in social values and in the understanding and management of complex forest ecosystems mean there is always uncertainty in the information used in AAC determinations. In making the large number of periodic determinations required for British Columbia's many forest management units, administrative fairness requires a reasonable degree of consistency of approach in incorporating these changes and uncertainties. To make my approach in these matters explicit, I have set out the following body of guiding principles. In any specific circumstance where I may consider it necessary to deviate from these principles, I will explain my reasoning in detail.

Two important ways of dealing with uncertainty are

(i) minimizing risk, in respect of which in making AAC determinations I consider particular uncertainties associated with the information before me and attempt to assess and address the various potential current and future, social, economic and environmental risks associated with a range of possible AACs; and

(ii) redetermining AACs frequently, in cases where projections of short-term timber supply are not stable, to ensure they incorporate current information and knowledge—a principle that has been recognized in the legislated requirement to redetermine these AACs every five years. This principle is central to many of the guiding principles that follow.

In considering the various factors that Section 8 of the *Forest Act* requires the chief forester to take into account in determining AACs I attempt to reflect, as closely as possible, operability and forest management factors that are a reasonable extrapolation from current practices. It is not appropriate to base my decision on unsupported speculation with respect to factors that could work to *increase* the timber supply—such as optimistic assumptions about harvesting in unconventional areas, or using unconventional technology, that are not substantiated by demonstrated performance—or with respect to factors that could work to *reduce* the timber supply, such as integrated resource management objectives beyond those articulated in current planning guidelines or the Forest Practices Code—'the Code'—which is now in transition to the Province's *Forest and Range Practices Act*.

In many areas the timber supply implications of some legislative provisions, such as those for landscape-level biodiversity, remain uncertain, particularly when considered in combination with other factors. In each AAC determination I take this uncertainty into account to the extent possible in context of the best available information.

As British Columbia progresses toward the completion of strategic land-use plans, in some cases the eventual timber supply impacts associated with land-use decisions resulting from various regional and sub-regional planning processes remain subject to

some uncertainty before formal approval by government. In determining AACs I will not speculate on timber supply impacts that may eventually result from land-use decisions not yet finalized by government.

In some cases, even when government has made a formal land-use decision, it is not necessarily possible to fully analyze and account for the consequent timber supply impacts in a current AAC determination. Many government land-use decisions must be followed by detailed implementation decisions requiring for instance the establishment of resource management zones and resource management objectives and strategies for those zones. Until such implementation decisions are made it would be impossible to fully assess the overall impacts of the land-use decision. In such cases the legislated requirement for frequent AAC reviews will ensure that future determinations address ongoing plan-implementation decisions. Wherever specific protected areas have been designated by legislation or by order in council, these areas are deducted from the timber harvesting land base and are not considered to contribute any harvestable volume to the timber supply in AAC determinations, although they may contribute indirectly by providing forest cover to help in meeting resource management objectives such as for biodiversity.

In the Arrow TSA, much clarification of land and resource use has been provided by government's Kootenay-Boundary Higher Level Plan Order, which guides many aspects of current management as addressed in my considerations in many sections of this document.

Where appropriate, I will consider information on the types and extent of planned and implemented silviculture practices as well as relevant scientific, empirical and analytical evidence on the likely magnitude and timing of their timber supply effects.

Some have suggested that, given the large uncertainties present with respect to much of the data in AAC determinations, any adjustments in AAC should wait until better data are available. I agree that some data are not complete, but this will always be true where information is constantly evolving and management issues are changing. Moreover, in the past, waiting for improved data created the extensive delays that resulted in the urgency to redetermine many outdated AACs between 1992 and 1996. In any case, the data and models available today are superior to those available in the past, and will undoubtedly provide for more reliable determinations.

Others have suggested that, in view of data uncertainties, I should immediately reduce some AACs in the interest of caution. However, any AAC determination I make must be the result of applying my judgement to the available information, taking any uncertainties into account. Given the large impacts that AAC determinations can have on communities, no responsible AAC determination can be made solely on the basis of a response to uncertainty. Nevertheless, in making my determination, I may need to make allowances for risks that arise because of uncertainty.

With respect to First Nations' issues, I am aware of the Crown's legal obligations resulting from decisions in recent years in the Supreme Court of Canada. The AAC that I determine should not be construed as limiting the Crown's obligations under these decisions in any way, and in this respect it should be noted that my determination does

not prescribe a particular plan of harvesting activity within the Arrow TSA. It is also independent of any decision by the Minister of Forests with respect to subsequent allocation of the wood supply.

Overall, in making AAC determinations, I am mindful of my obligation as steward of the forest land of British Columbia, of the mandate of the Ministry of Forests as set out in Section 4 of the *Ministry of Forests Act*, and of my responsibilities under the Code and under the *Forest and Range Practices Act*.

Because the new regulations of the *Forest and Range Practices Act* are designed to maintain the integrity of British Columbia's forest stewardship under responsible forest practices, it is not expected that the implementation of the legislative changes will significantly affect current timber supply projections made using the Code as a basis for definition of current practice.

The role of the base case

In considering the factors required under Section 8 of the *Forest Act* to be addressed in AAC determinations, I am assisted by timber supply forecasts provided to me through the work of the Timber Supply Review program for TSAs and TFLs.

For each AAC determination for a TSA a timber supply analysis is carried out using an information package including data and information from three categories—land base inventory, timber growth and yield, and management practices. Using this set of data and a computer simulation model, Timberline's Critical Analysis of Schedules for Harvesting (CASH6 version 6.21) for the Arrow TSA, a series of timber supply forecasts is produced, reflecting different decline rates, starting harvest levels, and potential trade-offs between short- and long-term harvest levels.

From this range of forecasts, one is chosen in which an attempt is made to avoid both excessive changes from decade to decade and significant timber shortages in the future, while ensuring the long-term productivity of forest lands. This is known as the 'base case' forecast, and forms the basis for comparison when assessing the effects of uncertainty on timber supply. The base case is designed to reflect current management practices.

Because it represents only one in a number of theoretical forecasts, and because it incorporates information about which there may be some uncertainty, the base case forecast for a TSA is not an AAC recommendation. Rather, it is one possible forecast of timber supply, whose validity—as with all the other forecasts provided—depends on the validity of the data and assumptions incorporated into the computer simulation used to generate it.

Therefore, much of what follows in the considerations outlined below is an examination of the degree to which all the assumptions made in generating the base case forecast are realistic and current, and the degree to which any adjustments to its predictions of timber supply must be made, if necessary, to more properly reflect the current situation.

Such adjustments are made on the basis of informed judgement using current available information about forest management that may well have changed since the original information package was assembled. Forest management data is particularly subject to change during periods of legislative or regulatory change, or during the implementation of new policies, procedures, guidelines or plans. Thus it is important to remember that while the timber supply analysis with which I am provided is integral to the considerations leading to the AAC determination, the AAC is not determined by calculation but by a synthesis of judgement and analysis in which numerous risks and uncertainties must be weighed. Depending upon the outcome of these considerations, the resulting AAC may or may not coincide with the base case forecast. Moreover, because some of the risks and uncertainties considered are qualitative in nature, once an AAC has been determined, further computer analysis of the combined considerations may not confirm or add precision to the AAC.

Base case for the Arrow TSA

The base case in the current timber supply analysis incorporates a number of changes in input data and methodology from the base case generated for the previous AAC determination effective April 30, 2001. These differences include the use of:

- new forest cover typing in phase 1 of the Arrow vegetation resource inventory (VRI) completed in 2002 and updated for disturbance to 2003, with timber volumes estimated using MOF's Variable Density Yield Predictor (VDYP) version 6;
- new Predictive Ecosystem Mapping (PEM) to define ecosystems;
- improved site productivity estimates using site index correlated to ecosystems (i.e. Site Index — Biogeoclimatic Ecosystem Classification or SIBEC);
- improved terrain stability mapping assumptions for potentially unstable soils;
- updated visual landscape inventory (VLI) and improved modelling of areas managed for visuals with localized visually effective green-up (VEG) heights;
- green-up of 2.5 metres where identified in the Kootenay-Boundary Higher Level Plan Order (KBHLPO);
- other changes in the KBHLPO due to amendments and variances since the last determination (e.g. mature forest requirements);
- spatially placed old growth management areas (OGMAs) instead of aspatial old forest seral requirements;
- revised methods to account for wildlife tree patch retention;
- updated operability mapping;
- volume gain projections for use of improved seed;
- volume reductions to account for identified wildlife; and
- spatially modelling cutblock adjacency for first 20 years of the harvest forecast.

Due to these and other changes, the current and previous base case projections are not directly comparable in some respects. Comprehensive details of the assumptions made in representing current forest management in the Arrow TSA in the 2004 base case are

provided in the timber supply analysis report and many are also discussed in relevant sections of this rationale.

In the 2004 base case, the harvest flow objectives included maintaining or increasing the current AAC for as many decades as possible with a gradual, controlled decline in harvest levels if required to reflect forest management assumptions. The objectives also included achieving a maximum even-flow long-term supply where the growing stock is stable.

The resulting forecast maintained the current AAC of 550 000 cubic metres per year for seven decades, followed by a substantial 25 percent increase in the eighth decade to a long-term maximum sustainable harvest level of 690 000 cubic metres per year. The increase primarily reflects the use of improved site productivity estimates (i.e. use of SIBEC) and genetic gains for managed stands that are projected to result in higher productivity than estimated in the inventory for existing unmanaged stands that have not yet been harvested.

From my review of the timber supply analysis, including detailed discussions with Forest Service analysts, I see no reason why the base case forecast should not provide a suitable basis of reference for use in my considerations in this determination. In fact, the spatial aspects of the model provide additional support that the projected timber supply will be achievable operationally over time through a pattern of harvests configured in a manner compatible with operational planning guidelines and requirements.

In addition to the base case forecast, I was provided with a number of sensitivity analyses and projections of alternative harvest flows carried out using the base case as a reference. All of these analyses, and others as noted below, have been helpful in the considerations and reasoning leading to my determination, which are documented as follows.

Consideration of Factors as Required by Section 8 of the *Forest Act*

Section 8 (8)

In determining an allowable annual cut under this section the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area

Land base contributing to timber harvest

- general comments

The total area of the Arrow TSA that is directly managed by the BC Forest Service (e.g. excluding protected areas and private land) is estimated to be 605 640 hectares. About 112 373 hectares (19 percent) of this total land base is either non-forest or sparsely treed areas called non-productive forests. The remaining 493 267 hectares (81 percent) is considered productive forest, however of this, over half, about 57 percent, is considered in the timber supply analysis as unavailable for harvesting. The main reasons that forests

are unavailable is because they are considered inoperable, unmerchantable, environmentally sensitive, or need to be retained to address management objectives for riparian areas or old growth management areas. The current area estimated to be economically and environmentally suitable for harvesting—the 'timber harvesting land base'—covers 210 275 hectares or 35 percent of the total TSA land base (and 43 percent of productive forest). The timber harvesting land base now estimated for the TSA is approximately 8074 hectares (4 percent) larger than that assumed in the previous timber supply review.

Deriving the timber harvesting land base includes making a series of deductions from the productive forest land base to account for factors that effectively reduce the suitability or availability of the productive forest area for economic or ecological reasons. In timber supply analysis, assumptions, and if necessary, projections, must be made about these factors, prior to quantifying appropriate areas to be deducted from the productive forest area to derive the timber harvesting land base. A detailed accounting of the areas deducted is given in the timber supply analysis report. My consideration of these deductions follows.

- inoperable areas

Those portions of the TSA which are not physically accessible for harvesting, or which are not feasible to harvest economically, are excluded in deriving the timber harvesting land base. In the analysis, a total of 204 000 hectares were removed as inoperable. In the analysis that supported the previous AAC determination, the area was assumed to be 120 390 hectares — a considerably lower number. This difference is primarily due to a change in non-productive forest classification with the new vegetation resource inventory and the order in which deductions are made to the timber harvesting land base.

The most recent operability mapping was completed in 1991 for the entire Arrow TSA. The Arrow Forestry Association, comprising the major licensees in the TSA, updated the operability line in 1998 and this resulted in 3800 hectares of additional timber harvesting land base that was included in the analysis. The additional area was a result of harvested or approved cutblocks located above the operability line.

The Total Chance Blocking project in 1998, which was discussed in the previous rationale, resulted in 3464 hectares of additional timber harvesting land base that was included in the analysis that supported the previous AAC determination. However, upon closer examination, district staff felt the areas are not, in fact, operable and should not have been included. The current analysis does not include these areas.

As raised in the previous rationale, district staff remain concerned about isolated areas included in the timber harvesting land base that are operationally and economically inaccessible for harvesting. Staff believe the isolated areas to be either narrow bands of timber above existing cutblocks but below the operability line, or areas unlikely to ever be harvested due to access constraints. On an overview helicopter flight of the TSA, district staff identified examples of these concerns to me. Based on a map review of four landscape units for the previous timber supply review, district staff identified that these

isolated areas represent about a 0.5 percent (about a 1000-hectare) reduction in the timber harvesting land base.

A review and report stemming from the Arrow Innovative Forestry Practices Agreement (IFPA) on these isolated areas was accepted by district BCFS staff. The report concluded that the isolated areas were left because of economics and access and are now unlikely to be harvested and should not be part of the timber harvesting land base. The timber supply analysis supporting the base case, however, assumes these isolated areas are part of the timber harvesting land base.

A sensitivity analysis assessed the impact of a 10 percent decrease in the timber harvesting land base relative to that assumed in the base case. Although the initial base case harvest could be maintained for one decade, harvest volumes would decrease 10 percent relative to base case projections for the remaining decades in the forecast horizon. The sensitivity analysis, however, examined impacts far in excess of the expected impact of excluding these isolated areas from the timber harvesting land base.

I accept that the isolated areas in question may represent a 0.5 percent overestimation in the size of the timber harvesting land base and have taken this risk into account in my 'Reasons for Decision'. This overestimation impacts timber supply in the short- and mid-term since the areas will no longer be isolated in the long term as second-growth forests mature.

District staff are concerned additional isolated areas could be created and, due to lack of resources, have not been able to undertake a review of the 1991 operability line. I encourage BCFS staff and licensees to identify and track these isolated areas that are not expected to be harvested, and also to monitor harvesting performance on both sides of the operability line. In that way, areas assumed to be inoperable can be better estimated in support of the next determination.

- environmentally sensitive areas

Environmentally sensitive areas (ESAs) in the Arrow TSA were identified in forest inventory work completed during the 1970's for recreation, avalanche areas and unstable soils. ESA deductions for values other than soils remain unchanged from the previous timber supply analysis.

Terrain stability mapping (TSM) undertaken for portions of the TSA provide a better assessment of potentially unstable soils and were used in the timber supply analysis to estimate ESAs for soils where available. The chief forester recommended in the last determination that the methods for excluding areas with sensitive or unstable soils from the timber harvesting land base based on TSM be refined given that it likely overestimated timber supply impacts. An alternative approach was developed for this timber supply analysis based on a proposal by the Arrow Forestry Association in 2000 and its review by the former chief forester.

The refined approach using TSM, that is described more fully in the 2004 timber supply analysis report, excluded a total of 25 765 hectares from the timber harvesting land base due to ESAs including 5927 hectares inside community watersheds. This is less than the

32 359 hectares excluded for ESAs in the previous timber supply analysis. As in the previous analysis, the current approach generally places a relatively higher constraint on ESAs located within community watersheds. BCFS district staff accept the proposed deductions for ESAs including unstable soils as a reasonable accounting for this factor.

From these considerations I find that ESAs were properly recognized and reasonably reflected in the timber supply analysis. I therefore accept the ESA deductions as suitable for the purposes of this determination.

- sites with low timber productivity

In the last AAC determination, the chief forester recommended that harvesting performance in sites with low productivity be monitored. A study therefore was undertaken that led to a 2002 report on *Harvesting Performance in Problem Forest Types and Low Sites*. This report provided guidance in defining sites with low productivity that should be excluded from the assumed timber harvesting land base for the current timber supply analysis. The report concluded that sites with less than 150 cubic metres of merchantable volume per hectare should not be considered harvestable.

As a consequence, stands greater than 140 years of age with less than 150 cubic metres per hectare of merchantable volume were excluded from the timber harvesting land base in the analysis. For stands less than 140 years of age, if projected volumes (using VDYP) at maturity were not expected to produce 150 cubic metres per hectare of volume, then they were also excluded from the land base. Based on these approaches, 4144 hectares were deducted to account for areas having low timber productivity in the timber supply analysis.

District staff believe the approach taken to define sites with low productivity that are unlikely to be harvested are based on the best available information. I therefore accept the deductions applied in the base case as appropriate for use in this determination.

- unmerchantable forest types

Unmerchantable forest types, also called problem forest types, are physically operable and do not qualify as low productivity sites, yet are not utilized due to a high degree of decay or due to marginal merchantability. These types are either wholly or partially excluded from the timber harvesting land base in the timber supply analysis.

In the last AAC determination, the chief forester recommended that district staff review the criteria used for identifying problem forest types and to monitor performance in these stands. A study, as previously mentioned, was undertaken that led to a 2002 report on *Harvesting Performance in Problem Forest Types and Low Sites*. This report provided guidance in assessing unmerchantable stands and the area that should be excluded from the timber harvesting land base. The approach taken in the analysis, which considered the guidance in the 2002 report and is documented in the 2004 timber supply analysis report, resulted in a 8885-hectare deduction from the timber harvesting land base.

This approach resulted in a higher percent reduction of >140 years of age hemlock-leading and 141 to 250 years of age balsam stands, as recommended in the 2002 report, relative to what was assumed in the previous 2000 timber supply analysis.

BCFS district staff believe the higher reductions accurately represents the level of harvesting performance in these types over the last 5 years and is confirmed by a cursory review of proposed cutblocks in forest development plans.

In considering this information, I am satisfied that the approach taken represents a reasonable accounting for this factor for the purposes of this determination.

- deciduous species

Deciduous forest types are those stands dominated by deciduous broad-leaved species. All deciduous-leading forest types were excluded from the timber harvesting land base for a total reduction of 7676 hectares. All deciduous volumes in coniferous-leading stands were also excluded from volume estimates in the base case. Deciduous species common to the TSA include aspen, black cottonwood and paper birch.

BCFS district staff confirm that deciduous species are not currently utilized in the Arrow TSA. Although there is some demand to utilize deciduous species for flooring or other products, the stands in the TSA generally do not have the quality logs required.

The policy regarding the billing of deciduous volumes and whether they should be charged to the AAC cut control is under review. Given the importance of deciduous volumes to stand-level biodiversity, including wildlife tree retention, it is likely that the licensees in the Arrow TSA will reserve the deciduous and therefore not remove and scale or include deciduous volumes in the AAC. For other units, deciduous volumes have normally only been charged to the AAC if those volumes actually contributed to the determination.

Although there is some uncertainty with respect to the outcome of this policy review, for the purposes of this determination, I am satisfied that the assumptions in the timber supply analysis with respect to deciduous species reflect current practice. Any deciduous species utilized or charged to the AAC in the future can be taken into account in subsequent determinations.

- roads, trails and landings

In the analysis, separate estimates were made, by methods explained in the timber supply analysis report, to reflect reductions to the timber harvesting land base already incurred by existing roads trails and landings, and those to be expected in the future. The resulting reductions were 5898 hectares for existing and 12 742 hectares for future roads, trails and landings.

To account for existing roads and trails in the TSA, an average right-of-way width of 15 metres was applied to roads, and 4 metres for trails, to the total length of roads and trails captured in the data files. This resulted in a 4706-hectare reduction in the timber harvesting land base for existing roads and trails. A 3 percent reduction was applied to the total area of stands 40 years of age and younger to account for landings; this led to an 1192-hectare reduction to the land base. BCFS district staff believe the reductions applied to existing roads, trails and landings are reasonable.

To account for future roads, trails and landings, reductions were applied to stands 41 years of age and older after the first projected harvest of each stand. Reductions of 3 percent for roads, 2 percent for trails and 2.4 percent for landings (7.4 percent in total) were applied in the analysis. The assumptions used were similar to those used in the previous timber supply analysis and were based on review of year-end disturbance reports.

In the previous determination, it was recommended that the methods then used to estimate reductions to the land base to account for roads, trails and landings be refined to reduce uncertainty. Forest licensees commissioned a study that suggested the reductions be 6.3 percent for future roads and landings, and 3.3 percent for trails. BCFS staff and licensees, however, felt that the suggested reduction for trails was too high, and that a reduction of around 2 percent would be more realistic based on professional judgement. The adjusted combined effect therefore suggests an 8.3 percent reduction to the land base. District staff believe that this is within the accuracy of the estimates or professional judgement to the 7.4 percent assumed in the base case and that, therefore, the analysis provides reasonable land base adjustments for this factor.

I have reviewed the information with BCFS staff and am I satisfied that there has been an appropriate accounting for roads, trails and landings in the timber supply analysis. I am satisfied there is no undue risk posed to timber supply as a result of any small uncertainties in the assumptions. Any uncertainty about estimates for future roads, trails and landings affects timber supply in the long term and therefore poses no risk to short-term timber supply.

- timber licence reversions

Timber licences (TLs) are old tenure arrangements that give a licensee exclusive rights to harvest merchantable timber within the licence area and therefore do not contribute to the AAC. Once these areas have been harvested, all future harvesting rights revert to the Crown and future harvests from the area will then contribute to the harvest for the TSA which contains the TL area.

In the timber supply analysis, 1171-hectares of TLs that had not already been deducted due to other netdown factors were removed from the land base. All of these TL areas are anticipated to be harvested before the expiry of the tenures in 2025. In the analysis, a reversion schedule approximated the return of these areas to the timber harvesting land base. District staff conclude that the analysis reasonably reflects expected reversions. I am therefore satisfied that timber licence reversions were appropriately accounted for in the base case projection.

- woodlot licences

The *Forest Act* requires AACs determined for TSAs to be exclusive of the areas and timber volumes allocated to woodlot licences. When woodlot licences are issued from a TSA, the required volumes are first allocated from an appropriate apportionment under the AAC for the TSA. Then, in the next AAC determination for the TSA, the TSA land base is reduced by the area of Crown land in all the woodlot licences issued since the

previous determination, and the total volume in the issued woodlot licences is excluded from contributing to the AAC for the TSA.

The existing woodlots in the TSA area are not included in timber harvesting land base and do not contribute in the analysis to meeting forest cover requirements. Eight woodlots in the TSA area are eligible to have their existing areas increased. Several approval considerations need to be applied so some of these woodlots may not get increased. If they were all approved, district staff estimate 1123 hectares and harvest volume of 2583 cubic metres per year (about 0.5 percent of the current AAC) could be withdrawn from the TSA.

I am satisfied that the timber supply analysis addressed woodlots appropriately since existing licences were not part of the base case while potential woodlot additions were included. For this determination, in keeping with my guiding principles, I will not speculate on allocation decisions that have not yet been made. Once the amount of area being added to woodlots is approved it can be accounted for in the next determination. At any rate, the proposed woodlot additions do not represent a significant pressure on timber supply based on the information provided.

- protected areas strategy

The province's protected areas strategy has two goals. Goal 1 is to protect viable representative examples of the natural diversity of the province. Goal 2 is to protect special natural, cultural heritage and recreational features of the province that are not captured in Goal 1 areas.

The Kootenay-Boundary Land Use Plan (KBLUP) advanced the Goal 1 and 2 process for the region including the Arrow TSA. Goal 1 decisions have been made with new protected areas being designated provincial parks. All existing designated parks and protected areas were excluded from the timber harvesting land base, however they do contribute in the analysis to achieving forest cover requirements such as for old growth retention in landscape units.

The KBLUP Implementation Strategy recommended 10 500 hectares be allocated for Goal 2 areas in the region. A follow-up process recommended in 2001 that five candidate Goal 2 areas, totalling 1150 hectares, be designated as provincial parks within the Arrow TSA. In keeping with this recommendation, no harvesting has been approved or is envisioned in the five areas. The process to actually designate the candidate parks, however, has been in abeyance.

Nearly 75 percent (852 hectares) of the 1150-hectare Goal 2 areas were deducted from the land base for other forest management reasons such as riparian reserves, deciduous, merchantability, etc. In the timber supply analysis, 298 hectares that had not already been deducted for other netdown factors were removed from the timber harvesting land base to account for Goal 2 candidate protected areas. This represents about 0.14 percent of the land base.

In keeping with my guiding principles, I will not speculate on land use decisions that have not yet been made. Therefore, for the purposes of this determination, the candidate

Goal 2 areas represent a small upward pressure on timber supply over the full forecast horizon and I have accounted for this in my 'Reasons for Decision.' Once the Goal 2 areas are designated, they can be excluded from contributing to timber supply in a subsequent determination.

Since government has made a recommendation to designate the candidate Goal 2 areas, I am understandably supportive of operational decisions to not harvest these areas. It is important, however, that the land use decision to designate the areas be addressed in a timely manner so that the issue does not continue to linger in abeyance. I support any efforts on the part of district staff to work with MSRM to bring the issue of designation to resolution.

- riparian habitats

Riparian areas along streams, lakes and wetlands provide key habitat for fish and wildlife and help conserve water quality and biodiversity. The Forest Practices Code (Code) and the *Forest and Range Practices Act* (FRPA) provide for riparian reserve zones (RRZs) that exclude timber harvesting and riparian management zones (RMZs) that restrict timber harvesting in order to protect riparian habitats. In the timber supply analysis, the default RRZ and RMZ provisions under the Code, that are similar under FRPA, were factored into the base case.

There is no default legal requirement to provide a RRZ along small streams that provide fish habitat or are located in community watersheds ("S4 streams"), consequently no reductions were made in the timber harvesting land base to account for reserves on these streams in the analysis. However providing a reserve can be considered both a best management practice and current management for some of these streams. District staff believe that a 4 metre average width better reflects current and expected practices on S4 streams. This results in about 685 hectares (about 0.3 percent) reduction in the land base relative to the base case.

I reviewed the information regarding riparian habitat and I accept that it is appropriate to take into account the exclusion of an additional 685 hectares, about 0.3 percent of the land base, in order to reflect current and expected practices in the Arrow TSA for small streams. I have accounted for this downward pressure over the full forecast horizon in my 'Reasons for Decision.'

- old growth management areas

Old seral stage forest retention is an important aspect of landscape-level biodiversity. Old forest requirements are specified in the Kootenay-Boundary Higher Level Plan Order (KBHLPO) that has legal effect under the Forest Practices Code and FRPA. Old growth management areas (OGMAs) were spatially identified in the Arrow TSA to meet these old forest requirements and were removed from the timber harvesting land base. This resulted in 13 416 hectares of additional area (that had not already been deducted due to other netdown factors such as inoperability) being removed from the land base. The 13 416-hectare net reduction represents about 25 percent (1:3 ratio) of the total 54 080-hectare OGMA area that was deducted from the land base.

OGMAs can be legally established by MSRM as a land use objective under FRPA (previously called a higher level plan under the Code). The OGMAs selected for use in the timber supply analysis have not been legally established; they were based on areas identified by MSRM and revised by licensees. The revised areas have about 38 000 fewer hectares than the areas identified by MSRM; the revised areas have not been approved by MSRM. If the ratio of net reductions to total reductions (1:3) for the areas specified in the analysis applied to the 38 000-hectare area, this would represent about a 9500-hectare further reduction to the land base to reflect the areas identified by MSRM.

Because the issue of spatially locating OGMAs remains unresolved, a sensitivity analysis was undertaken to determine the impact of achieving the KBHLPO aspatially (i.e. by not having fixed OGMAs). The sensitivity analysis enables the initial harvest levels to be maintained before declining 45 000 cubic metres per year starting in decade four. This impact continues to decade 6 before a long-term harvest flow is achieved in decade 7 that is similar to the base case.

The sensitivity analysis, however, assumed the old seral stage requirements needed to be met in the short-term, whereas in fact the KBHLPO allows for requirements in low biodiversity emphasis areas to be incrementally achieved over time. Therefore the sensitivity somewhat overstates the likely impacts associated with meeting old forest targets aspatially.

In reviewing this information, I have concluded in my 'Reasons for Decision' that the timber supply analysis has likely underestimated the effects of old forest retention on reductions to the timber harvesting land base. I recognize an unquantified downward pressure on timber supply in the short- and mid-term to account for potential discrepancies in the location of OGMAs. Although unquantified, the upper limit of the impact on the land base is likely to be no more than 5 percent based on the estimated 9500-hectare disparity with areas identified by MSRM.

- *wildlife tree patches*

Wildlife tree patches are an important part of stand-level biodiversity. The Code and FRPA both provide for the retention of wildlife trees in harvested areas. In the timber supply analysis, currently mapped wildlife tree patches within the forest development plan data layer were removed from the timber harvesting land base to account for existing harvesting. This resulted in a 792 hectare, or 0.3 percent, additional reduction in the land base.

An evaluation was undertaken to account for wildlife tree patch retention for future cutblocks. The evaluation estimated that an additional 2.5 percent of the land base was needed to retain wildlife tree patches in the future. This was modelled in the analysis as a 2.5 percent reduction in yield tables rather than as a reduction to the timber harvesting land base. BCFS district staff reviewed this work and found it be consistent with approaches taken in other units and acceptable for use in the Arrow TSA.

The district manager has provided a letter to licensees that identifies the percent that must be retained for wildlife tree patches based on the policy guidance in the Landscape Unit

Planning Guide (LUPG). Based on the LUPG, the weighted average wildlife tree retention within the timber harvesting land base of 3.4 percent is reflected in the letter. District staff, however, have not determined if this suggested slightly higher retention level more appropriately reflects current practices. District staff, therefore, accept the 2.5 percent estimate used in the timber supply analysis as appropriate at this time.

After considering the approach undertaken in the timber supply analysis, and comments from BCFS staff, I conclude that the base case has reasonably accounted for existing and future wildlife tree patches for the purposes of this determination. Operational information about future wildlife tree retention levels needs to be collected so that this information can then be factored into subsequent determinations. In the meantime, current relatively small uncertainties in this factor should not pose an undue risk to short-term timber supply.

- identified wildlife

"Identified wildlife" are those wildlife species and plant communities that have been approved by MWLAP as requiring special management. The province's Identified Wildlife Management Strategy (IWMS) addresses plant communities and species at risk, and regionally significant species, that have not been accounted for by other existing management strategies. For example, for protected areas, biodiversity, riparian management or ungulate winter range.

Identified wildlife can be protected through the establishment of wildlife habitat areas (WHAs) with objectives or general wildlife measures. The objectives or general wildlife measures may preclude or constrain timber harvesting activity depending on the requirements of individual identified wildlife species or communities.

Government policy direction under the Code, which continues under FRPA, is to limit the timber supply impact of the IWMS to one percent. Impacts greater than this can still be addressed by government if required to protect species at risk, but using other tools such as through land use objectives under FRPA (called higher level plans under the Code). Operational policy direction has been to initially allocate the one percent impact equally to each forest district with acknowledgement that this approach can be refined if warranted.

Although no WHAs have been established or proposed in the Arrow TSA at this time, work to address identified wildlife in the future is fully expected. The *Forest Planning and Practices Regulation* under FRPA also enables species at risk to be addressed as an objective set by government for wildlife provided MWLAP issues a notice. A notice has been issued related to three species for the Arrow Boundary Forest District. The estimated effect on the timber harvesting land base of the notice is 192 hectares.

The timber supply analysis accounted for this factor in two ways. First, a no-harvest buffer was established around known goshawk and great blue heron nesting sites (stick nests) that are protected under federal and provincial legislation. This resulted in a 48-hectare net area being deducted from the timber harvesting land base. Second, to

account for the IWMS, all existing stand yields were reduced by one percent to reflect government policy on expected timber supply impacts.

Although WHAs have not been established in the TSA, the decision to account for a one-percent timber supply impact of implementing the IWMS has been made by government. Therefore I consider the approach taken in the timber supply analysis to be appropriate for the purpose of accounting for identified wildlife in this determination.

- Dewdney Trail

The Dewdney Trail is a heritage trail designated under the *Heritage Conservation Act*. The approved management plan for the trail has legal effect on forest practices under the authority of this Act. In the plan, the trail corridor is defined as a 100-metre reserve zone on either side of the trail, and the timber within the trail corridor is not available for harvest unless salvage is required for disease, insect or fire management. The trail corridor area therefore was excluded from the timber harvesting land base in the timber supply analysis. This resulted in 251 total area deduction from the land base with sequential net area deduction (after reductions due to other factors) of 93 hectares.

In reviewing this information, I am satisfied that the trail was appropriately accounted for in the timber supply analysis.

Existing forest inventory

- current inventory

Vegetation Resource Inventory (VRI) generally consists of two phases: phase 1 based on photo interpretation, and phase 2 consisting of ground sampling. The 2004 timber supply analysis was completed with the use of phase 1 of the new VRI completed for the Arrow TSA in 2002. The VRI was updated for disturbance and growth to 2003 for use in the analysis. Phase 2 ground sampling work is not yet complete but should be available in the fall of 2005.

The use of the phase 1 VRI in the timber supply analysis employs the best available information and therefore I am satisfied its use is appropriate for this determination. Improved inventory information from phase 2 can be accounted for in subsequent AAC determinations including those made under s. 59.1 of the *Forest Act* (see *Innovative Forest Practices Agreement*).

- species and age considerations

Commercial tree species most prevalent in the timber harvesting land base are Douglas-fir, lodgepole pine, western larch, Engelmann spruce, subalpine fir, western hemlock and western red cedar. The timber supply analysis report provides information on current age class distribution for the Arrow TSA as well as projected distributions in the future.

In reviewing this information, it was noted that the TSA currently has a large gap in forest ages due to relatively few forests being between 11 to 70 years of age. As a consequence,

the harvesting of older natural stands is required to fill in the mid-term timber supply gap that is expected to be very tight in 60 to 80 years until regenerated stands reach harvestable age.

I accept the data provided to me on species and age as it is based on the recent VRI and represents best available information for use in this determination.

- *volume estimates for existing unmanaged stands*

In the timber supply analysis, estimates of timber volumes in existing unmanaged stands were projected using the new VRI phase 1 inventory attributes and the Variable Density Yield Prediction (VDYP) model version 6.6. The analysis considers unmanaged stands to be those older than 25 years where Douglas-fir or spruce are dominant, and remaining stands older than 15 years.

For the purposes of the timber supply analysis, 96 analysis units were created based on VRI attributes. A yield curve was developed for each analysis unit using VDYP to assign current volumes and to grow volumes in the simulation model until harvest. Special harvest yield curves were developed for analysis units where partial harvesting has occurred or is expected. MSRM resource inventory staff reviewed the proposed yield curves and analysis units for the Arrow TSA and found them to be appropriate.

As noted earlier, VRI phase 2 ground sampling is underway in the TSA but is not yet complete. Phase 2 ground sampling will help calibrate and improve volume estimates for unmanaged stands. As an interim measure, to assess the accuracy of predicted volumes, ground data from the 1995 forest inventory audit were compared with the new VRI. The comparison suggests that VRI phase 1 estimated volumes underestimate actual volumes (using audit ground data) from 13 to 45 percent. An underestimation of heights in the phase 1 component of the inventory appears to account for most of this volume difference.

After reviewing these differences, MSRM staff stratified the audit ground data based on age. This resulted in a strong indication that the volume on stands less than 100 years of age are significantly underestimated while stands greater than 100 years are slightly overestimated. The younger stands have a larger underestimated stand height (about 3 metres) than the older stands (about 1.5 metres). This evaluation also suggests that height underestimation, as opposed to bias in the yield prediction models, accounts for the majority of the volume difference.

The results of these comparisons with the 1995 inventory audit need to be cautiously interpreted. The sampling design for the inventory audit was not designed for use for subsequent new inventory polygons. The sampling errors for most of the comparisons made are very high. Nevertheless, the comparisons do strongly suggest that volume estimates for unmanaged stands have been underestimated in the timber supply analysis.

A sensitivity analysis that increased natural site index heights by 3 metres (which increases natural stand volumes) was performed. Initial harvest levels could be increased 22 percent from 550 000 cubic metres per year in the base case to 670 000 cubic metres per year, and this level could be maintained until long-term harvest level of 700 000 cubic

metres per year is reached in decade 8. A sensitivity analysis also assessed the impacts of decreasing natural site index heights by 3 metres. This resulted in the need to decrease short-term timber supply to 430 000 cubic metres – 22 percent less than assumed in the base case.

In reviewing this information, although not statistically conclusive, there is a strong indication that phase 1 VRI heights have been underestimated and that this has led to an underestimation of projected volumes for unmanaged stands. The actual amount of the underestimation remains uncertain at this time. However a conservative estimate of the general magnitude of this underestimation is at least 10 percent based on existing information. The VRI phase 2 ground sampling work underway in the Arrow TSA should address volume and height uncertainties and reduce uncertainty in this factor but are not available for this determination. Phase 2 results can be used in future AAC determinations. For this determination, I recognize a significant unquantified upward pressure on short- and mid-term timber supply in my 'Reasons for Decision' based on this factor.

Expected rate of growth

- *site productivity estimates*

Inventory data include estimates of site productivity for each forest stand, expressed in terms of a site index. The site index is based on the stand's height as a function of its age. The productivity of a site largely determines how quickly trees grow. This in turn affects the time seedlings will take to reach green-up conditions, the volume of timber that can be produced, and the ages at which a stand will satisfy mature forest cover requirements and reach a merchantable size.

The most accurate estimates of site productivity come from stands between 30 and 150 years of age. The growth history of stands less than 30 years of age has not been long enough to give accurate measurements of site productivity. Estimates derived from older stands underestimates site productivity as these stands are often well past the age of maximum height growth and have often been affected by disease, insects and top damage as they reach advanced age. The underestimate of site productivity has been verified in several studies (e.g. Old-Growth Site Index or OGSI study) in the province. These studies have confirmed that when old stands are harvested and regenerated, site productivity realized is generally higher than inventory-based site index estimates of older stands would predict.

In the timber supply analysis for the Arrow TSA, site productivity estimates for existing unmanaged stands were based on the new VRI. Site productivity estimates for existing and future managed stands are based on ecosystem classification (using Predictive Ecosystem Mapping – PEM) and site index estimates for each biogeoclimatic ecosystem classification unit (using SIBEC information). BCFS Research Branch maintains the SIBEC database and branch staff approved the PEM work completed for the Arrow TSA in 2003 with qualifications. Improvements to PEM for use with SIBEC estimates can be made to address the qualifications noted such as the provision of additional plot data;

these efforts can improve PEM and corresponding site productivity estimates in support of future determinations.

The average site index for the entire timber harvesting land base was increased 26 percent from 15.3 metres height at 50 years based on VRI for unmanaged stands to 19.3 metres height at 50 years using PEM/SIBEC for managed stands.

Although the PEM/SIBEC estimates for site productivity for managed stands are based on best available information, there is some uncertainty about their accuracy given the level of sampling and monitoring of these regenerated managed stands in the Arrow TSA. A sensitivity analysis was performed that addressed this uncertainty. If managed site index estimates were decreased by 3 metres height at 50 years of age (to be closer to VRI estimates), the initial annual harvest level of 550 000 cubic metres would need to step down (about 8 percent per decade) to 460 000 cubic metres in decade 3. Long-term annual harvest levels would be 525 000 cubic metres – about 24 percent below the 690 000 cubic metres projected in the base case.

If managed site index estimates were increased by 3 metres, short- and mid-term harvest levels could increase 18 percent to 650 000 cubic metres per year, while long-term harvest levels could increase 22 percent to 845 000 cubic metres per year relative to the base case.

I have reviewed the information with BCFS staff about site productivity estimates for both managed and unmanaged stands and conclude that the estimates used in the timber supply analysis are based on the best available information and are therefore suitable for use in this determination. The sensitivity analysis demonstrates how important a good estimate of site index for managed stands can be in forecasting timber supply in the Arrow TSA for the full forecast horizon. As consequence, I recommend that managed stands in the TSA be monitored for growth as there is a need to validate site productivity estimates in support of future determinations. With improved information such as additional plot data, improvements to PEM should be considered so site productivity estimates can be refined in support of subsequent AAC determinations.

- volume estimates for regenerated managed stands

In the analysis, the standard BCFS growth and yield model Table Interpolation Program for Stand Yields or TIPSY (version 3.0b) was used to estimate the timber volumes for regenerated managed stands. The model was applied to all future regenerated stands and to all existing stands 25 years old or less where Douglas-fir or spruce are dominant, and to remaining existing stands 15 years old or less.

TIPSY requires input information such as species composition, regeneration delay, density and site productivity that describe establishment conditions. Site productivity estimates were based on PEM/SIBEC as previously discussed. Other information was derived from either from silvicultural records or expectations of establishment conditions for particular sites. For modelling purposes, future managed stands are grouped into analysis units in order to obtain the information needed for TIPSY.

The TIPSY projections are initially based on ideal conditions, assuming full site occupancy and the absence of pests, diseases and significant brush competition. However, certain operational conditions, such as a less-than-ideal distribution of trees, the presence of small non-productive areas, endemic pests and diseases, or age-dependent factors such as decay, waste and breakage, may cause yields to be reduced over time. Two operational adjustment factors (OAFs) are therefore applied to yields generated using TIPSY, to account for losses of timber volume resulting from these operational conditions. OAF 1 is designed to account for factors affecting the yield curve across all ages, such as small stand openings. OAF 2 accounts for factors whose impacts tend to increase over time such as pests, disease, decay, waste and breakage. In the Arrow TSA timber supply analysis, the standard provincial modelling reductions of 15 percent for OAF 1 and 5 percent for OAF 2 were applied.

Armillaria is a root disease that forms a component of most managed and natural forest stands in the southern third of BC including those in the Arrow TSA. Because of concern that the impacts of the disease could significantly affect timber supply in the TSA, the chief forester has encouraged in previous determinations that BCFS staff better quantify the potential effects of this root disease. A recent study undertaken in 2004 in the Arrow TSA estimated that growth losses could be 30 percent for low severity, 46 percent for medium severity, and 63 percent for high severity infestations at a stand age of 100 years. However, the study also noted the difficulty in assessing the distribution and severity of Armillaria root rot infections across the TSA because only 25 percent of infected trees show above ground symptoms.

Armillaria root rot is of particular concern in the Interior Cedar-Hemlock (ICH) zone. To assess a range of possible TSA-wide impacts, three potential severity distributions were assumed and investigated in a sensitivity analysis. Based on these distribution scenarios, stand level volume losses for managed Douglas-fir stands in the ICH ranged from 42 to 50 percent. Douglas-fir stands in the ICH that could be affected by root rot cover about 20 percent of the timber harvesting land base in the TSA.

Sensitivity analysis assessed the impact of the three distribution scenarios on timber supply. For all three scenarios, initial base case harvest levels of 550 000 cubic metres per year can be maintained for 6 decades. The impacts are noticeable in the long term where harvest levels are projected to be between 635 000 and 645 000 cubic metres per year which is about 7 to 8 percent less than the 690 000 cubic metres shown in the base case.

The long-term timber supply impact of 7 to 8 percent is likely a conservative estimate as Armillaria root disease likely impacts Douglas-fir stands outside the ICH zone and other species although to a lesser extent. In addition to root rot losses, volume losses to spruce stands due to the impact of leader weevil are also potentially significant.

I appreciate efforts that have been made to better quantify the impact of Armillaria root rot on timber supply. Although I recognize how difficult this can be, in reviewing the information provided me, I believe the efforts made to assess the impacts represent a reasonable approach for use in this determination. The results show that the standard OAFs applied in the timber supply analysis do not reflect potential volume losses due to

root rot. The sensitivity analysis provides some assurance that uncertainty in this factor is not likely to affect short-term timber supply. In my determination I do account in my 'Reasons for Decision' for the potential long-term timber supply impact of root rot disease on timber supply, which is likely to be in excess of 7 percent. I also recognize the need for refinements to be undertaken in estimating volume losses from Armillaria root rot so that this can be reflected in subsequent determinations.

- genetic worth

Use of select seed with improved genetic traits can increase timber volumes of managed stands in the long term and quicken the time for a stand to reach a green-up height or reach minimum harvestable age, thereby also having an influence on short- and mid-term timber supply. The quantity and quality (genetic worth) of select seed has increased in the past decade, and is projected to increase further, throughout the province including the Arrow TSA.

In the timber supply analysis, the volume gains expected at harvest age from the use of select seed were accounted for by modifying the TIPSY growth curves for regenerated stands. The application of genetic gain in the model took into account the species planted, seed planning zones and the year of stand establishment. For example, genetic worth is expected to increase over time, while no genetic improvements are projected for stands at elevations greater than 1700 metres or for stands dominated by western red cedar.

BCFS district staff noted some contraventions to Seed Transfer Guidelines that help ensure the correct seed is planted on different sites and elevations. The amount of area affected by the contraventions is not known so any timber supply effects have not been quantified.

The approach taken in the timber supply analysis to account for volume gains in managed stands from the use of select seed was reviewed by BCFS Tree Improvement Branch staff who found the approach to be appropriate. In reviewing the information with BCFS district staff, notwithstanding the contraventions, I conclude that the base case reasonably reflects the use of select seed in the TSA for the purposes of this determination.

- minimum harvestable ages

A minimum harvestable age is an estimate of the earliest age at which a forest stand has grown to a harvestable condition. The minimum harvestable age assumption mainly affects when second-growth stands will be available for harvest within the timber supply model. This, in turn, affects how quickly existing stands may be harvested such that a stable flow of timber harvest may be maintained. In practice, many forest stands will be harvested at much older ages than the minimum harvestable age, due to economic considerations or forest cover constraints on harvesting that arise from managing for such values as visual quality, wildlife and water quality.

The timber supply analysis assumed that minimum harvestable ages for all managed and unmanaged stands was the age in which 95 percent of the culmination of mean annual

increment is achieved. This approach follows the direction from the chief forester provided at the last determination.

BCFS district staff accept the approach taken for this timber supply analysis but note uncertainty regarding minimum harvestable ages as there is little operational experience to draw upon as current harvesting is focused on older stands. Significant harvesting of regenerated managed stands is not expected to begin in the TSA until decade 6 based on projections in the timber supply analysis.

Sensitivity analysis that increases minimum harvestable ages by 10 years projects that initial harvest levels in the base case can be maintained for 2 decades before declining 11 percent to 495 000 cubic metres per year. This mid-term harvest level can be maintained until decade 8 before substantially increasing to 700 000 cubic metres per year in the long term. Decreasing assumed minimum harvestable ages enables initial harvest levels to be 595 000 cubic metres per year, an 8 percent increase relative to the base case. This can be maintained for 7 decades before increasing to 635 000 cubic metres in the long term, which is 8 percent less than shown in the base case.

In reviewing this information, I consider the assumptions used in the timber supply analysis to account for minimum harvestable ages to be appropriate for use in this determination. I recognize there is some uncertainty in this factor, but sensitivity analysis suggests this represents low risk that initial harvest levels identified in the base case are too high. I encourage licensees and district staff to work together and explore ways in which current uncertainties in this factor can be reduced in support of subsequent determinations.

(ii) the expected time that it will take the forest to become re-established on the area following denudation:

Regeneration delay and impediments to prompt regeneration

Regeneration delay is the period between harvesting and the time at which an area becomes occupied by a specified minimum number of acceptable, well-spaced seedlings. In the timber supply analysis, a regeneration delay of two years was assumed for all forest stands. The previous 2000 timber supply analysis also assumed a two-year regeneration delay; this was based at that time on a review by district staff of the previous ten years of performance that was confirmed by major licensees. District staff undertook a more recent cursory review of the last four years of regeneration delay via the Reporting Silviculture Updates and Land status Tracking System (RESULTS) database, and concluded the two year delay is still a reasonable estimate.

BCFS district staff have noted no significant impediments to prompt regeneration, such as brush competition, in the Arrow TSA and none were reflected in the timber supply analysis.

In reviewing the information presented to me by district staff, I am satisfied that, on average, the 2-year regeneration delay assumed in the analysis adequately reflects current practice.

Not-satisfactorily-restocked areas

Not-satisfactorily-restocked (NSR) areas are those where timber has been removed, either by harvesting or by natural causes, and a stand of suitable forest species and stocking has yet to be established. Areas where the standard regeneration delay has not yet elapsed since harvesting are considered 'current' NSR and fluctuate with the amount of disturbance (e.g. harvesting, fires) currently taking place. Since 1987 there is a legal obligation to reforest harvested areas. Where a site was harvested prior to 1987 and a suitable stand has not yet been regenerated, a classification of 'backlog' NSR is applied.

In the Arrow TSA, about 2200 hectares of current NSR is regenerated on average within a two-year regeneration delay period.

Currently about 1600 hectares of backlog NSR is estimated for the TSA. The previous timber supply analysis assumed that 70 percent of the backlog NSR would be restocked in 10 years. Recent backlog NSR practices, however, suggests a longer time frame should be assumed. The current timber supply analysis therefore assumes 15 years will be needed to restock 70 percent of the backlog NSR, and that the remaining 30 percent will restock at a constant rate over the subsequent 45 years. Once backlog NSR areas are projected to be restocked, VDYP yield curves for unmanaged stands are applied to estimate volumes over time.

I have considered the information and have no concerns about NSR assumptions that would require adjustments to the base case for this determination.

(iii) silvicultural treatments to be applied to the area:

Silvicultural systems

The silvicultural system predominately used in the Arrow TSA has been clearcutting often with reserves such as wildlife tree patches for stand-level biodiversity. Partial cutting systems are used in a small portion of the TSA.

The timber supply analysis assumed clearcutting for most of the TSA with the exception of a chart area representing about 4 percent of the harvest where partial cutting is modelled. BCFS district staff consider the analysis to have appropriately represented current practices. I accept that the base case has adequately addressed silvicultural systems for this determination.

Incremental silviculture

In general, incremental silviculture includes activities such as commercial thinning, juvenile spacing, pruning, fertilization, that are not part of the basic silviculture activities required to establish a free-growing forest stand.

No incremental silvicultural activity is assumed in the timber supply analysis. BCFS district staff believe this reasonably reflects current practice since very little incremental silvicultural activity (including no commercial thinning) has occurred in the Arrow TSA since the last determination.

The level of incremental silviculture undertaken in a given management unit is very dependent on funding and is difficult to project into the future. If the amount of incremental silviculture actually practised differs significantly from that assumed in the analysis, this can be reflected in future AAC determinations. For the purposes of this determination, I am satisfied with the treatment of this factor in the analysis.

(iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area:

Utilization standards

Utilization standards define the species, dimensions and quality of trees that are harvested and removed from an area during harvesting operations. In the timber supply analysis, the utilization standards applied were consistent with those used in other southern interior units. BCFS staff indicate that the standards reflect current levels of utlization in the TSA.

Although utilization policies have recently changed, BCFS staff do not believe this will substantially affect AAC volumes given current waste assessment procedures. Any unused volumes that fall within the assumed utilization standards are likely to be charged to the AAC.

I accept the assumptions employed in the base case as a reasonable accounting of utilization standards. I will not speculate if utlization practices may or may not change in the future in response to government policies and procedures. If practices do in fact change, this can be addressed in subsequent determinations.

Decay, waste and breakage

The VDYP model used in the timber supply analysis to project volumes for existing unmanaged stands incorporated estimates of volumes of wood lost to decay, waste and breakage. These estimates of losses have been developed for different areas of the province based on field samples. As previously discussed, operational adjustment factors (OAFs) were used in the timber supply analysis to account for decay, waste and breakage in volume estimates for regenerated managed stands. I am satisfied that standard and appropriate procedures were followed to account for decay, waste and breakage in the base case.

(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production:

Integrated resource management objectives

The Ministry of Forests is required under the *Ministry of Forests Act* to manage, protect and conserve the forest and range resources of the Crown and to plan the use of these resources so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are coordinated and integrated. The Forest Practices

Code, the *Forest and Range Practices Act* and other legislation provide for, or enable, the legal protection and conservation of timber and non-timber values. Accordingly, the extent to which integrated resource management (IRM) objectives for various forest resources and values affect timber supply must be considered in AAC determinations.

The timber supply analysis has addressed some IRM objectives through reductions in the timber harvesting land base. I have accounted for these factors in 'Land base contributing to timber harvesting.' In this section, I account for IRM objectives where the land base continues to contribute to timber supply but are subject to various forest cover and adjacency constraints.

- cutblock adjacency, forest cover and green-up

To manage for resources such as water, wildlife and scenic areas, and to avoid concentrating harvesting-related disturbance in particular areas, operational practices limit the size and shape of cutblocks and maximum disturbances (areas covered by stands of less than a specified height), and prescribe minimum green-up heights required for regeneration on harvested areas before adjacent areas may be harvested. Green-up requirements help to achieve objectives for water quality, wildlife habitat, soil stability and aesthetics. Adjacency, green-up and forest cover objectives guide harvesting practices to provide for a distribution of harvested areas and retained forest cover in a variety of age classes across the landscape.

In the timber supply analysis for the Arrow TSA, in order to represent the desired conditions necessary to meet the various objectives in different areas of the TSA, the timber harvesting land base was categorized into resource emphasis zones with varying forest cover requirements. Resource emphasis zones were identified for integrated resource management, scenic areas, ungulate winter range, caribou habitat, mature forests, and community and domestic watersheds. There is a great deal of overlap in the resource emphasis zones; the analysis captures all of the forest cover requirements for each applicable zone that applies to a particular area. The forest cover requirements for each resource emphasis zones are addressed in the following sections.

To show the impact of all adjacency and forest requirements modelled in the base case, a sensitivity analysis was undertaken where all the requirements were removed. This enabled short-term timber supply to increase 21 percent to 665 000 cubic metres for 8 decades and long-term timber supply to increase 20 percent to 825 000 cubic metres relative to the base case.

- integrated resource management (IRM) zone

In the timber supply analysis, requirements for integrated resource management (IRM) zone apply to the entire timber harvesting land base and include a minimum green-up height of 2.5 metres and a maximum disturbance limit of 25 percent. The analysis estimated achievement of green-up heights from yield curves. The 2.5 metre green-up height reflects the direction in the Kootenay-Boundary Higher Level Plan Order (KBHLPO). As previously mentioned, if another emphasis zone were to occur in the IRM zone, the requirements in the analysis for that zone would also apply.

The timber supply analysis identified the Enhanced Resource Development Zones for Timber (ERDZ–T), as provided for by KBHLPO, but assumed the IRM zone forest cover constraints apply. Currently, no special forest practices are being applied in the ERDZ–T.

The maximum disturbance level of 25 percent is a surrogate for the operational practice of limiting harvesting of a block until an adjacent cutblock has reached green-up height. The timber supply model (CASH6) used in the analysis enables the spatial nature of cutblock adjacency to be directly modelled in order to more realistically account for this factor. In the base case, the first 20-years were modelled with the spatial adjacency constraint after which only the maximum disturbance constraint was applied. Due to uncertainty of block design, the use of spatial adjacency beyond initial decades can introduce unexpected problems in the model.

A sensitivity analysis was undertaken where spatial adjacency constraints were removed, but aspatial constraints still applied. The effects were minor resulting in a 5000 cubic metre per year increase (about a one percent) in short- and long-term harvest levels.

In reviewing this material, I am satisfied that the IRM zone was adequately modelled in the base case to reflect the KBHLPO and current practices in the TSA. Should practices in the ERDZ-T change, this can be taken into account in subsequent AAC determinations.

- *scenic areas*

Careful management of scenic areas (e.g. along important travel corridors) is an important IRM objective requiring that visible evidence of harvesting be kept within acceptable limits. The Code and FRPA enable scenic areas to be designated and visual quality objectives (VQOs) to be established to limit the amount of visible disturbance due to forest practices.

Visual landscape inventories are carried out to identify, classify and record those areas of the province that are visually sensitive, and appropriate visual quality classes (VQCs) are recommended. VQC and VQO often use categories like 'preservation,' 'retention,' 'partial retention,' 'modification', or 'maximum modification'—to identify levels of alteration appropriate to particular areas. Guidelines to meet the VQOs include setting a maximum percentage of a specified area or 'viewshed' that is allowed to be harvested (i.e. level of alteration) at any one time. Guidelines also include setting a 'visually effective green-up' or 'VEG' height at which a stand of reforested timber is perceived by the public to be satisfactorily greened-up.

Scenic areas in the region, including the Arrow TSA, were designated in the Kootenay-Boundary Higher Level Plan Order (KBHLPO). The district manager has provided instructions under the Code to forest licensees to use the recommended visual quality classes (VQC) in the visual landscape inventory. These instructions have been brought forward under the *Government Actions Regulation* under FRPA and therefore are required for use in forest stewardship plans.

The timber supply analysis used the scenic areas and VQCs consistent with the KBHLPO and the district manager's instructions. About 13 959 hectares of modification, 62 012 hectares of partial retention, 11 172 hectares of retention and 26 hectares of

preservation were recognized as resource emphasis zones in the timber harvesting land base. Nearly 42 percent of the land base is in one of these zones. The upper limit of alteration for each VQC category was assumed in the analysis. VEG height was calculated using a digital terrain model to account for factors like slope; average VEG height ranged from 5.5 metres for modification to 6.8 metres for retention.

Sensitivity analysis that increased VEG heights by 1.5 metres had no effect on short-term timber supply but resulted in a 9 percent decrease in available timber supply in decades 6 and 7 and a minor 2 percent decrease in the long term. Decreasing assumed VEG heights by 1.5 metres increased harvest levels relative to the base case by about 4 percent throughout the forecast horizon.

Sensitivity analysis was also performed that assessed the impact of increasing or decreasing the levels of alteration by 5 percent. Increasing allowable alterations resulted in a 6 percent increase in harvest levels relative to the base case throughout the forecast horizon. Decreasing levels of alteration by 5 percent indicates the need to decrease short- and mid-term timber supply by 10 percent and long-term timber supply by 8 percent.

BCFS staff are in the process of legally establishing VQOs under FRPA and ensuring consistency with KBHLPO including scenic areas. Any changes to the assumptions that were used in the timber supply analysis are not expected to be significant.

BCFS staff note that although there is some harvesting performance in the scenic areas, there is also avoidance of more heavily constrained areas, for example, where scenic areas and domestic or community watersheds overlap. Staff are also concerned that consistently using the maximum allowable alterations as modelled in the base case may be optimistic, however it is too early to judge whether or not this will be achieved.

I recognize the concern of staff about the allowable alterations modelled in the analysis, and am mindful of the sensitivity analysis that demonstrates that timber supply is sensitive to allowable percent disturbance across the forecast horizon. However, I also need to be mindful of the Minister's memo to the chief forester regarding visual resources (Appendix 4). The memo, in essence, indicates that maximum allowable alterations should be considered in AAC determinations as this approach was used in the cited 1996 report *The Forest Practices Code: Timber Supply Analysis.* Further there is limited operational data to either support or refute the assumptions used in the base case.

In reviewing this information with BCFS staff, I am satisfied that the timber supply analysis appropriately accounted for scenic areas in the base case. In my helicopter review of portions of the TSA I witnessed some good examples of harvesting performance in scenic areas. However, although there has been some harvesting performance in scenic areas, it is evidently not up to the level assumed in the timber supply analysis. I encourage district staff and forest licensees to work cooperatively to obtain appropriate levels of performance in scenic areas. This is particularly important so that the rest of the land base is not unduly impacted. Monitoring should also be conducted to document the performance in scenic areas as well as the levels of alteration that can be achieved by VQC or VQO category so modelling assumptions can be verified or refined.

- ungulate winter range

Most of BC's ungulate species occur in the Arrow TSA including Rocky Mountain bighorn sheep, white-tailed and mule deer, moose, mountain goat, elk and caribou. For deer, elk and moose, areas located at lower elevations below 1100 metres adjacent to large lakes or reservoirs and valley bottoms provide the winter habitat needed for these species when significant snow accumulations occur. Government can designate specific zones as ungulate winter range (UWR) where management objectives or measures are established.

In the timber supply analysis, 21 443 hectares (about 10 percent) of the timber harvesting land base was zoned as winter range consistent with the Kootenay-Boundary Land Use Plan – Implementation Strategy (KBLUP-IS). The analysis assumed that a minimum area of cover with older forests of 40 percent with the minimum age of older forests being 100 years. Further, a green-up height of 2.5 metres and the 25 percent maximum allowable disturbance similar to the IRM zone was modelled.

In December 2004, the legal objective for managing UWR under FRPA was established with the sign-off of a notice under section 4 of the *Forest Planning and Practices Regulation;* the notice reflects the provisions in the KBLUP-IS. The notice is considered interim until UWRs can be established under s. 10 of the *Government Actions Regulation;* this later process is under review. MWLAP is proposing to increase the area in UWR under s. 10, but ease the forest cover constraints. A timber supply assessment showed the combined effects would provide a very slight upward pressure on timber supply relative to the base case.

MWLAP and BCFS staff feel the timber supply analysis reasonably reflects current practice in the TSA. I concur with that assessment that ungulate winter ranges has been appropriately accounted for in the base case. When actions are taken to establish UWRs under s. 10 of the *Government Actions Regulation*, then this can be factored into the next determination. Based on the information provided, even if these decisions proceed, they appear to pose low risk to timber supply.

- caribou habitat

The Arrow TSA includes two distinct populations of mountain caribou: the South Selkirks (or international) herd and the Central Selkirks (or Slocan) herd. Caribou habitat and their management as a consequence of forest practices are addressed in the Kootenay-Boundary Higher Level Plan Order (KBHLPO).

The timber supply analysis reflects the direction in the KBHLPO in 2004. About 13 640 hectares of caribou habitat are recognized including distinctive types of habitat with specific requirements regarding the minimum area of older forest to be retained and the minimum ages that define older forests.

In response to the federal *Species at Risk Act*, MWLAP has established multi-stakeholder recovery implementation groups. The intent is to propose actions or measures to recover an otherwise declining population.

Refined caribou resource emphasis zones proposed by a regional caribou committee was accepted by government through a recent March 18, 2005 variance to the KBHLPO. BCFS staff advise that the slight increase in the overall zones for both populations in the Arrow TSA and the refined management direction in the KBHLPO variance are not expected to result in a net increase in timber supply impact across the TSA.

In reviewing the approach taken in the timber supply analysis to account for caribou, and in discussions with MWLAP and BCFS staff, I am confident that the timber supply analysis has adequately accounted for caribou habitat in the base case.

- grizzly bear habitat

The KBHLPO gives legal effect to key aspects of the Kootenay-Boundary Land Use Plan – Implementation Strategy (KBLUP-IS). The KBHLPO requires that important habitat for grizzly bears, including forested area adjacent to avalanche paths and denning sites, be provided for through the deployment of requirements to retain mature and/or old forests.

The timber supply analysis addresses the KBHLPO requirements for mature and/or old forests through old growth management areas and mature forest requirements. The analysis did not spatially model the retention of mature or old forests in important grizzly bear habitats since their location has yet to be mapped in the TSA.

MWLAP and BCFS staff advise that current operational practices in the TSA implement the provisions of the KBLUP-IS management strategy for grizzly bear habitat. For example, generally only one side of an avalanche track that contains high value grizzly bear habitat is harvested at one time, with harvesting on the other side being delayed for about 60 years until sufficient hiding and thermal cover has been re-established. Licensees often use wildlife tree patches as a means of securing retained mature and older forests for important grizzly bear habitat.

In reviewing this information with staff, it is my view that the many other provisions in the timber supply analysis that address non-timber values in the TSA provide for an adequate accounting of the timber supply effects of protecting important grizzly bear habitat. These other provisions include the retention of old growth management areas, wildlife tree patches and mature forest cover for other wildlife species. The KBHLPO direction is that grizzly bear habitat can be adequately managed through the deployment of other requirements in the order. The approach in the timber supply analysis is generally consistent with that direction. Therefore I accept the approach in the analysis as suitable for use in this determination.

- wildlife management area

The Hamling Lakes wildlife management area (WMA), administered under the *Wildlife Act*, was established in 1998. The Hamling Lakes WMA provides important habitat for mountain caribou and other ungulates as well as species such as grizzly bears and wolverines. The Hamling Lakes WMA compliments the adjacent Goat Range park by including lower elevation habitats that support the seasonal migration of wildlife. WMAs are not protected areas since forest harvesting and subsurface uses are not prohibited

activities. The MWLAP regional manager has the authority to permit use of land or resources in the WMA.

A draft operation management plan for the Hamling Lakes WMA was completed in 2003 which emphasized the protection of critical winter habitat for caribou and high value foraging areas (avalanche tracks) for grizzly bears. In recognition of the wildlife values identified in the draft plan, a KBHLPO variance was approved that transferred mature forest retention requirements from an adjacent landscape unit with less suitable habitat to the landscape unit containing the WMA. Timber supply impacts of the WMA are therefore managed through the KBHLPO, and this was reflected in the timber supply analysis for the Arrow TSA.

A number of forest cover constraints that reflect the direction in the KBHLPO are factored in the timber supply analysis that address the Hamling Lakes WMA including caribou habitat, old growth management areas and the additional mature forest requirements transferred from an adjacent landscape unit. I am therefore satisfied that the base case has appropriately accounted for expected timber supply impacts associated with the WMA for the purposes of this determination.

- *community and domestic watersheds*

Nearly one-half (47 percent) of the timber harvesting land base in the Arrow TSA was identified as community and domestic watersheds in the timber supply analysis. The watersheds have been identified in the TSA as part of the Kootenay-Boundary Land Use Plan. Four distinctive types of watersheds were recognized in the timber supply analysis where the maximum disturbance ranged from 15 percent to 25 percent, and where the minimum height for disturbed areas was defined as 6 metres. The intent of these assumptions was to model current management as best as possible, as reflected in equivalent clearcut area (ECA) guidelines designed to protect water quality and quantity.

ECA guidelines are used as a red flag to trigger further hydrologic study to assess factors such as proximity of roads to streams, number of stream crossings, and bank and channel stability. ECAs do not provide a hard maximum disturbance limit as was modelled in the timber supply analysis. BCFS district staff believe that operationally the disturbance constraints used in the timber supply analysis could be exceeded.

Clearly, the appropriate management of community and domestic watersheds is a very important issue in the Arrow TSA. I recognize the importance of ECA limits in triggering further study of the important hydrologic considerations for each individual watershed, and the important role of professional judgement in decisions regarding opportunities for further harvest.

In review of this information with district staff, there could be a potential small unquantified upward pressure on timber supply since the constraints used in the analysis to emulate ECA limits are not, in fact, hard limits. Monitoring harvesting performance in these watersheds should allow for a better accounting of this factor in future. In the meantime, I accept the timber supply analysis as a reasonable accounting of this important factor for the purposes of this determination.

- botanical forest products

The harvesting of botanical forest products is an important activity in the Arrow TSA. Mushrooms, berries, vegetative/floral parts and other plant species used in wild crafting are examples of products being harvested. Harvesting of pine mushrooms can have a significant seasonal influence on the local economy. The full magnitude of harvesting botanical forest products in the TSA, however, is not known.

BC Timber Sales and BCFS research have collaborated on a multi-year study to address the relationship between timber harvesting and the habitat and productivity of pine mushrooms.

The timber supply analysis did not address or specify management criteria for botanical forest products. In reviewing this factor, I find it to be reasonable for the analysis to not specify constraints on timber supply. I note that the Kootenay Boundary Higher Level Plan Order has no special provisions for botanical forest products. Several existing constraints on timber supply in the analysis that are aimed to help ensure a diversity of forest conditions exist in the TSA should provide conditions needed to support the variety of botanical forest products harvested in the TSA. In any event, should additional information or direction be provided in the future, this can be factored into future determinations.

- mature forests

Mature and old forests are an important element of landscape-level biodiversity. As discussed under "Land base contributing to timber harvesting", old growth management areas were spatially identified in the Arrow TSA and removed from the timber harvesting land base. I have accounted for old forest retention in my review of that factor (see *old growth management areas).*

The Kootenay-Boundary Higher Level Plan Order (KBHLPO) was amended since the last determination. The amended KBHLPO requires mature forest retention in a limited number of landscape units and biogeoclimatic ecosystem classification variants.

The timber supply analysis reflected the direction in the amended KBHLPO in the development of the base case. I am therefore satisfied that mature forest requirements were adequately addressed for this determination.

- disturbances in stands outside the timber harvesting land base

Over one-half (57 percent) of the Arrow TSA is in productive forests outside the timber harvesting land base. These forests don't contribute to timber supply but can contribute to the achievement of non-timber values such as biodiversity, wildlife, watershed and visual resources. Although no timber harvesting is expected in stands outside of the timber harvesting land base, natural disturbances are expected due to factors such as fire.

The timber supply analysis modeled disturbance of stands outside the land base at a rate of 295 hectares per year for the first 50 years and 1016 hectares per year for the remaining 200 years of the forecast. However, the model precluded stands that were needed to meet forest cover requirements from being disturbed, when clearly natural disturbances could affect these stands. BCFS staff note, therefore, that the analysis overestimates the ability of these stands to contribute to non-timber objectives.

Not surprisingly, given the assumptions in the base case for this factor, a sensitivity analysis that assessed no disturbances outside the land base only had a minor effect (about one percent increase) on harvest levels in the short-term. No sensitivity analysis was undertaken to determine the potential effects of employing alternative assumptions such as randomly disturbing stands outside of the timber harvesting land base.

I concur with the assessment of staff that the timber supply analysis should have allowed for disturbance to occur in all stands outside the land base. Since no alternative analysis exists that has quantified this potential impact on timber supply, for the purposes of this determination, I recognize in my 'Reasons for Decision' an unquantified downward pressure on timber supply. I recommend before the next determination that an attempt be made to more accurately account for the impact the natural disturbances outside the timber harvesting land base in the Arrow TSA.

- cultural heritage resources

Archaeological Overview Assessments (AOAs) within the Arrow TSA were completed in 1996 and 2000 that identify archaeological site potential and provide an information base for more detailed assessments. Since the completion of the AOAs, few new archaeological sites have been found in the TSA. New sites tend to cover small areas and most are located outside the timber harvesting land base (e.g. in riparian reserves or on rock outcrops). The preferred management strategy for any sites within the timber harvesting land base is avoidance of harvesting such as through the establishment of a cutblock reserve.

The Ktunaxa Kinbasket Tribal Council completed a traditional use site inventory project for their asserted traditional territories in 1998. Part of the Arrow TSA is within this area.

BCFS staff believe the analysis reflects current management practices. In reviewing this information, I am satisfied that the base case harvest projections have reasonably accounted for this factor.

- habitat supply

In support of the timber supply analysis and sustainable forest management planning, forest licensees initiated cooperative habitat modelling work with MWLAP. Habitat indicators such as snag frequency, downed wood volume, percent hardwoods and shrub cover were projected over time for productive forests in the Arrow TSA.

I commend forest licensees for these initial efforts at habitat modelling and encourage them to continue to refine these predictive models. Such models provide useful information on the impacts of forest management activities over time and are particularly

useful if benchmark objectives for these resources are available. This information, for example, may be useful in assessing if FRPA requirements for the retention of coarse woody debris can be achieved through projected downed wood volumes.

(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber;

Other information

- harvest sequencing

In timber supply analysis, the order in which eligible stands are assumed to be harvested can affect the projected timber supply in a number of ways. Any difference between the modelling assumptions made and the order in which stands are actually harvested in operational practice must be examined and accounted for.

For the Arrow TSA timber supply analysis, forest stands with the most years over a minimum harvest age are harvested first. This "relative oldest first" harvest rule was also used in the previous analysis. In the last determination the chief forester contended that a more realistic approach would be somewhere between "relative oldest first" and a random ordering approach.

The simulation model used in the analysis is not able to randomly harvest stands available for harvest. As a result, the "relative oldest first" rule was used in the timber supply analysis.

The timber supply analysis for the Arrow TSA shows that the number of available forest stands needed to achieve the base case projection is very limited. In these situations, rules governing harvest sequence are less consequential. For example, a sensitivity analysis was undertaken that assessed the difference between the "relative oldest first" rule versus actually harvesting the oldest available forests first. The sensitivity indicated that this change in harvest rule had no impact on short- and mid-term timber supply and only a very small 5000 cubic metres per year (about 0.7 percent) decrease in the long term.

The base case harvest forecast does not appear to be that sensitive to changes in harvest sequence rules in the short term due to the low availability of stands for harvest. The use of the "relative oldest first" rule reasonably reflects what can be expected operationally in this TSA. I therefore am confident this factor has been adequately accounted for in the timber supply analysis.

- actual harvest level

The average AAC from 1999 to 2003 was 582 200 cubic metres. The actual annual harvest over this five year period was 597 025. This comparison shows that the AAC has been met or exceeded (as provided for under 5-year cut controls) over this period. Based on this information, there is no reason for me to believe the AAC can not be delivered based on past operational practices. I have taken this consideration into account in my determination.

Although very recent harvest history has met or exceeded the AAC, not all the volumes apportioned to licensees in the last formal cut-control period of 1997 to 2001 were utilized. This has led to 298 816 cubic metres of "undercut" volumes where the decision whether to carry-forward or re-apportion some or all of these volumes have yet to be made. If the short-term harvest level is temporarily increased to capture all or portions of the undercut, the inventory of mature timber will be utilized more rapidly than projected in the base case. Although I am mindful of the potential impact this could have on timber supply, in keeping with my guiding principles, I will not speculate on future decisions related to the undercut. It is unknown at this time whether or how much of the undercut will actually be harvested over the next few years. If harvesting of the undercut is authorized and proceeds, it can be reflected in the assumptions and inventory depletions that support the next timber supply analysis, and the resulting decrease in timber supply can be accounted for in future determinations.

- *Slocan Valley*

There has been a long history of forest operational planning delays and harvesting deferrals in the Slocan valley due to a number of issues. Despite the direction in the Kootenay-Boundary Higher Level Plan Order, and the guidance in the Kootenay-Boundary Land Use Plan – Implementation Strategy, local operating issues remain in portions of the valley that still challenge forest harvesting. Challenges exist because of pressures from local water users and environmental organizations.

In the previous determination, the chief forester did not partition the AAC in the Arrow TSA, but did set an expected harvest contribution of 81 700 cubic metres from five landscape units in the valley in order to support effective delivery of the overall AAC. The 4-year average annual harvest from the 5 landscape units since the last determination (from 2001 to 2004) has been 81 554 cubic metres which is nearly identical to that stated expectation.

Since the last determination, forest licensees, through discussions with local public groups, have narrowed the size of the area where difficult challenges remain that have caused harvest delays to eight more specific operating areas that are much smaller than the 5 landscape units. The eight operating areas, that are identified on a map, are called the Elliot, Anderson, Christian, Trozzo, Hasty, Hills, Winlaw and Perry. The operating areas represent 9495 hectares (about 4.5 percent) of the timber harvesting land base in the Arrow TSA.

A sensitivity analysis was undertaken to assess the impact of removing these eight operating areas from the timber harvesting land base. The sensitivity analysis shows that initial harvest levels relative to the base case can still be maintained for three decades but a 10 percent decrease would then occur from decades 4 to 8. An alternative harvest flow would be to reduce harvest levels by 4.5 percent (25 000 cubic metres per year) for the first 8 decades.

Recent harvesting performance suggests that the larger 5 landscape units within the Slocan Valley can contribute to the AAC in proportion to the amount of the timber

harvesting land base in those areas. The level of harvest contribution from the smaller eight operating areas identified by the licensees is less certain. Therefore, to avoid pressures on other areas of the TSA if harvesting does not occur in the eight Slocan Valley operating areas, a contribution of 25 000 cubic metres per year is needed, as reflected in the sensitivity analysis, from these operating areas.

In reviewing this information, and on a helicopter review of the Slocan Valley with district staff, I am confident that significant harvest contributions can be made within the larger landscape units in the valley. Given the challenges that remain in the eight more specific operating areas, and the importance of avoiding a significant mid-term decrease in timber supply, the harvest level contribution in the operating areas need to be tracked. I reflect on this matter further in my 'Reasons for Decision.'

- Innovative Forest Practices Agreement

All licensees with replaceable forest licences in the Arrow TSA have been working collaboratively together since 1998 under an Innovative Forest Practices Agreement (IFPA). A number of IFPA projects have been undertaken including the new vegetation resource inventory (VRI) used in this timber supply analysis. Under s. 59.1 of the *Forest Act*, IFPA licensees have an opportunity to propose an AAC uplift to the regional executive director in the Southern Interior Forest Region based on the projects undertaken. Arrow IFPA licensees may consider this when phase 2 of the VRI is completed. The timber supply analysis incorporated all of the work done by the IFPA to date, so no uncertainty in the base case is expected at this time based on this consideration.

- operational plans

Under the Forest Practices Code, forest licensees prepare forest development plans (FDPs) each year that propose a timber harvesting and associated development activity for the upcoming 5-year period. Approved FDPs in the Arrow TSA have an average of 3.0 years of approved cutblocks. A forest stewardship plan will be prepared under the *Forest and Range Practices Act.*

Although there are several factors that can constrain approval of cutblocks, BCFS staff report that most licensees are not having significant difficulties in identifying areas for proposed harvesting at this time due to current forest health issues associated with the mountain pine beetle. Licensees are proposing to salvage harvest damaged pine-leading stands in order to reduce potential unsalvaged losses.

The main difficulty in locating timber for harvesting in operational plans is in the eight operating areas in the Slocan Valley. I have already addressed this concern and account for this in my 'Reasons for Decision.'

- First Nations considerations

The Ktunaxa Kinbasket, Shuswap, and Okanagan Nations have asserted traditional territories within the Arrow TSA. The Westbank First Nation, a member of the Okanagan Nation Alliance, and the Ktunaxa Kinbasket Tribal Council are proceeding with land claim negotiations, including portions of Arrow TSA, as part of the treaty process. The Westbank First Nation signed Interim Measures Agreements in 2002 and 2003. The Ktunaxa Kinbasket Tribal Council signed two Interim Measures Agreements in 2003.

Forest and range agreements (FRAs) are interim agreements between MOF and eligible First Nations designed to provide for workable accommodation of aboriginal interests that may be impacted by forestry decisions during the term of the agreement until such time as those interests are resolved through treaty. FRAs provide First Nations a direct award forest tenure and a share of forestry revenues. All First Nations with asserted aboriginal interests in the Arrow TSA have been offered FRAs. FRA negotiations are on-going with some First Nations and bands who have expressed interest.

As discussed under my "Guiding Principles", it is inappropriate for me to attempt to speculate on the impacts on timber supply that may result from decisions that have not yet been made by government. Any decisions on treaty negotiations made in the future by government and First Nations can be reflected in subsequent AAC determinations.

Printed hard copies of the timber supply analysis reports were sent to First Nations with asserted traditional territories in the Arrow TSA. An accompanying letter was sent with the reports to encourage feedback on the analysis. Advertisements were also placed in local newspapers to announce the review period for the public and First Nations. Input received from First Nations included concerns regarding their capacity to respond and general concerns about process. No specific aboriginal interest issues were brought forward and no issues were raised about the timber supply analysis for the Arrow TSA and how my decisions might impact aboriginal interests.

While no information was provided on the location extent and nature of aboriginal interests in the TSA, in other areas of the province such interests often relate to cultural heritage resources, wildlife (hunting) and fish. I have discussed issues related to archaeological resources, some of which could provide an indication of areas associated with aboriginal interests, under *cultural heritage resources*, above. I concluded there that the base case reasonably accounted for management of these resources. The base case also accounts for management of wildlife and fish habitat through land base reductions and application of forest cover requirements. For example, fish habitat is in large part addressed through provisions to protect and conserve riparian habitat. In the absence of more specific information on aboriginal interests, I believe it is reasonable to conclude that the accounting in the base case for management of wildlife and fish habitat could provide for related aboriginal interests.

(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area;

Alternative harvest flows

The nature of the transition from harvesting old growth to harvesting second growth is a major consideration in determining AACs in many parts of the province. In keeping with the objectives of good forest stewardship, AACs in British Columbia have been and continue to be determined to ensure that short-term harvest levels are compatible with a smooth transition to medium- and long-term levels. Timber supplies need to remain sufficiently stable so that there are no inordinately adverse impacts on current or future generations. To achieve this, the AAC determined must not be so high as to cause later disruptive shortfalls in supply nor so low as to cause immediate social and economic impacts that are not required to maintain forest productivity and future harvest stability.

The base case harvest forecast for the Arrow TSA was developed subject to several assumptions; for example, the initial harvest level was set at the current allowable annual cut. In addition to the base case harvest forecast, there are many possible alternative forecasts with different starting harvest levels and different trade-offs between short- and long-term harvest levels. The analysis report provided two alternative forecasts using the same forest management assumptions. The maximum non-declining even-flow alternate harvest flow was found to 550 000 cubic metres per year, which is initially the same as the current AAC and the base case. The highest initial harvest level alternative harvest flow was found to be 710 000 cubic metres per year. At this level, it is necessary to decrease the harvest level by 10 percent per decade for 4 decades until a mid-term harvest level of 480 000 cubic metres is reached. After decade 7, the managed stands enable a slightly higher long-term harvest level of 705 000 cubic metres (about 2 percent higher) relative to the base case.

These alternative forecasts are described in more detail in the timber supply analysis report. In making my AAC determination I have considered both of these forecasts, in addition to the base case forecast and the many sensitivity analyses provided in the analysis report, as well as recent and current actual harvest levels in the TSA.

Community dependence on the forest industry

The timber supply analysis included a socio-economic assessment of the Arrow Boundary Forest District. The forest sector was found to provide 20 percent of the employment in the district, the second highest percentage, following the public sector at 31 percent. Other important sectors include other primary industries (18 percent), tourism (10 percent), construction (9 percent), and other basic sectors (13 percent).

The relative diversity of the local economy in the district is considered high while vulnerability to changes in the forest sector has been rated low to moderate. This suggests a relatively stable local economy.

Harvesting the current AAC in the TSA supports about $31 million in direct forest sector employment income of which $21 million (about 68 percent) is earned by residents in the TSA region. Harvesting the current AAC supports $59 million in total employment income that includes indirect employment supported by forest sector activity. About

$19 million of provincial revenue are generated from harvesting the AAC including stumpage revenue, forest industry taxes and employment income taxes.

As discussed earlier, actual harvest levels, on average, reflect the current AAC of 550 000 cubic metres per year in the TSA. Any increases or decreases in harvest levels are likely to have a corresponding impact on the employment income in communities within the TSA and provincial revenues. I have reflected on this information in determining an appropriate AAC for the Arrow TSA.

(c) the nature, production capabilities and timber requirements of established and proposed timber processing facilities;

This section of the *Forest Act* was repealed in 2003. [2003-31-2 (B.C. Reg. 401/2003)]

(d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia;

Minister's letter and memorandum

The Minister has expressed the economic and social objectives of the Crown for the province in two documents to the chief forester—a letter dated July 28, 1994 (attached as Appendix 3) and a memorandum dated February 26, 1996 (attached as Appendix 4).

This letter and memorandum provide a government view on forest stewardship, a stable timber supply, and allowance of time for communities to adjust to harvest-level changes in a managed transition from old-growth to second-growth forests, so as to provide for community stability.

The Minister stated in his letter of July 28, 1994, that 'any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability.' He placed particular emphasis on the importance of long-term community stability and the continued availability of good forest jobs. To this end he asked that the chief forester consider the potential impacts on timber supply of commercial thinning and harvesting in previously uneconomical areas in order to help maintain harvest levels. To encourage this the Minister suggested consideration of partitioned AACs.

I reviewed commercial thinning under *incremental silviculture;* BCFS staff note that no commercial thinning has occurred in the TSA since the last determination and none was assumed in the timber supply analysis. As discussed under *inoperability*, I have reviewed the operability assumptions in the timber supply analysis. I am satisfied that they are based on the best information currently available. The timber supply analysis demonstrates that harvest levels can be maintained in the short- and mid-term without commercial thinning or harvesting in previously uneconomic areas. Given this information, I see no helpful reason to establish specific harvest levels attributable to particular areas, species, or terrains (i.e. partition) in this TSA at this time to address commercial thinnings and previously uneconomic (inoperable) areas.

The Minister's memorandum addressed the effects of visual resource management on timber supply, asking that the constraints applied to timber supply to meet VQOs not be allowed to unreasonably restrict timber supply. As noted in *scenic areas*, the timber

supply analysis limited timber supply impacts from visual resource management by assuming the upper limit of alteration for each visual quality class. I am satisfied this approach addresses the objectives expressed by the minister and that the overall assumptions applied to scenic areas in the base case also reflects government's management objectives for the area as provided by the KBHLP Order.

Local objectives

The Minister's letter of July 28, 1994, suggests that the chief forester should consider important social and economic objectives that may be derived from the public input in the timber supply review where these are consistent with government's broader objectives. MOF guidelines for consultation described in *DFAM Interim Standards for Public and First Nations Review* were followed in the Arrow timber supply analysis. Despite the provision of opportunities for review, very few comments were received. No comments were provided on local objectives for this timber supply review.

In the last timber supply review, some local objectives were identified through public comments. These included a clean, healthy and environmentally sustainable future for the Slocan Valley, and the economic viability of local mills. I believe these previously expressed local objectives by some members of the public have validity for my consideration in this determination and I have taken them into account.

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

Unsalvaged losses

Unsalvaged losses are timber volumes destroyed or damaged by such agents as fire or disease, that are not recovered through salvage operations. In regenerated forests, a number of parasites, fungi or plants can kill trees or degrade the quality and value of logs.

Estimates for unsalvaged losses account for epidemic (abnormal) infestations and for factors that result in losses that are not recovered through salvage harvest programs and are not recognized in yield estimates. Timber volume losses due to insects and diseases that normally affect stands (endemic losses such as Armillaria root rot) are accounted for in inventory sampling for existing timber yield estimation or through other methods. Endemic losses associated with second-growth stands are addressed by application of operational adjustment factors (OAFs) as noted under *volume estimates for regenerated managed stands*.

The timber supply analysis assumed annual unsalvaged losses of 28 720 cubic metres over the next 100 years and deducted these volumes from the harvest forecast. This included 14 200 cubic metres from mountain pine beetles, 5800 cubic metres from wildfire, 5720 cubic metres from white pine blister rust, 2500 from windthrow and 500 cubic metres from Douglas-fir bark beetles. These estimates are based on those derived in the previous 2000 BCFS timber supply analysis for the Arrow TSA.

Since the last determination, there has been a significant increase in the level of bark beetle infestation primarily from mountain pine beetle but also grand fir engraver beetle

In addition, there have been two drought years where the incidence of fires across the southern interior have been at historical highs. Records for 2003 indicate approximately 75 hectares of operable forests burned that was not salvaged. In the 3 years prior to 2003 there were no significant fires. Despite the two recent drought years, district staff believe that, on average, the assumption used in the timber supply analysis base case reasonably reflects the unsalvaged losses due to fire in the Arrow TSA.

The small scale salvage program harvests between 38 000 and 50 000 cubic metres per year in the Arrow Boundary Forest District. The estimated volume of 20 000 cubic metres from the Arrow TSA in 2003/04 is not currently charged to the AAC. Although a portion of this harvest is expected to be part of the assumed unsalvaged losses in the timber supply analysis, some of the salvage harvest is from timber that contributes to the AAC. The portion of the small scale salvage harvest that contributes to the AAC can be billed to the Forest Service Reserve thereby generally removing the need to account for this harvest as a downward pressure on timber supply.

In reviewing this information, I am satisfied, based on the information provided, that unsalvaged losses due to fire appear to be reasonably accounted for in the base case. Despite record losses in 2003, the 4-year average losses since the last determination appear to be within the range of losses assumed in the timber supply analysis.

The incidence of bark beetle infestations has increased in the TSA since the last determination particularly due to mountain pine beetles. As discussed under *operational plans*, licensees are proposing to salvage harvest damaged pine-leading stands in order to reduce potential unsalvaged losses. To maintain medium-term timber supply at base case levels, any increase in harvests of pine-leading stands must be balanced with retention of other stand types for harvest in the medium term. However, mixed species stands with a pine component that may be harvested in the mid-term will have experienced volume losses due to bark beetles; these losses are not fully accounted for in the timber supply analysis. Therefore, in my 'Reasons for Decision' I have taken into account an unquantified downward pressure due to increased mountain pine and fir engraver beetle activity in the TSA that likely will cause unsalvaged losses to timber supply that are not reflected in the base case.

I recognize that a portion of the small scale salvage harvest is from timber that contributes to the base case in the timber supply analysis. However, the Forest Service Reserve likely captures this component of the harvest. Therefore, I am satisfied the base case has accounted for this consideration for the purposes of this determination.

Reasons for Decision

In reaching my AAC determination for the Arrow TSA I have made all of the considerations documented above and have reasoned from them as follows.

The 2004 timber supply analysis base case projection shows a harvest forecast maintained at the current AAC of 550 000 cubic metres per year for seven decades. This is followed by a substantial 25 percent increase in the eighth decade to a long-term maximum sustainable harvest level of 690 000 cubic metres per year.

In determining AACs, my considerations typically identify factors which, considered separately, indicate reasons why the timber supply may be either greater or less than the harvest levels projected for various periods in the base case. Some of these factors can be quantified and their implications assessed with reliability. Others may influence the assessment of the timber supply by introducing an element of risk or uncertainty, but cannot be quantified reliably at the time of the determination and must be accounted for in more general terms.

In my considerations, the following factors have been identified as reasons why the timber supply as projected in the base case may have been underestimated:

- *Volume estimates for existing unmanaged stands*: A significant unquantified upward pressure on short- and mid-term timber supply is expected due to strong indications that volume estimates for existing unmanaged stands assumed in the timber supply analysis have been underestimated. Results from the VRI phase 2 ground sampling work underway in the Arrow TSA are expected this fall 2005 and should provide a quantification of this volume underestimation. In the meantime, a conservative estimate of the general magnitude of this underestimation is at least 10 percent based on existing information.
- *Protected areas strategy*: In the timber supply analysis, the timber harvesting land base was reduced by 298 hectares or 0.14 percent to account for Goal 2 candidate protected areas. I recognize the efforts being made to harvest away from these candidate areas and expect this will continue until designation decisions are made. However, in keeping with my guiding principles, I will not speculate on land use decisions that have not yet been made. Therefore, for this determination, I recognize this as a small upward pressure on timber supply over the full forecast horizon.

The following factors have been identified as reasons why the timber supply projected in the base case may have been overestimated:

- *Old growth management areas*: Old growth management areas used in the timber supply analysis have not been legally established by MSRM. Discrepancies exist between the areas proposed by licensees and areas identified by MSRM. This could result in as much as a 9500-hectare additional reduction in the timber harvesting land base than was assumed in the base case. Until this issue is resolved, I recognize this as a potential unquantified downward pressure to timber supply in the short- and mid-term. Although unquantified, an upper bound to the maximum potential impact suggests no more than about 5 percent impact on the land base.
- *Volume estimates for regenerated managed stands – Armillaria:* The standard operational adjustment factors (OAFs) for regenerated stands that were applied in the timber supply analysis do not fully account for the effect of Armillaria root rot. A reduction likely in excess of 7 percent to long-term timber supply is estimated to account for this concern.
- *Inoperable areas*: Some areas that were classified in the timber supply analysis have been isolated by previous harvesting activity and are no longer considered operable. This represents an approximate 0.5 percent overestimation in the size of the timber

harvesting land base that can affect timber supply availability in the short- and mid-term.

- *Riparian habitats*: An additional 685 hectares may need to be excluded from the timber harvesting land base to account for reserves along small (S4) streams that provide fish habitat or are located in community watersheds. This represents a 0.3 percent downward pressure on timber supply for the full forecast horizon.
- *Disturbances in stands outside the timber harvesting land base*: The timber supply analysis assumed stands outside the timber harvesting land base needed to meet forest cover requirements would not be disturbed. Natural disturbances like wildfire could affect these stands. I therefore recognize this as an unquantified downward pressure on timber supply over the full forecast horizon. Due to the level of uncertainty, I am unable to place an upper or lower boundary on this effect.
- *Unsalvaged losses*: Recent increased mountain pine beetle infestations in the TSA has likely caused an underestimation of unsalvaged losses in the base case. Many attacked pine-leading stands likely can be salvaged, however the lodgepole pine component in mixed stands may be lost due to beetle. I recognize this as an unquantified downward pressure in the mid-term when many of these mixed stands would likely be harvested.

The above list of factors identifies eight areas of upward and downward pressure in the base case projection that must be considered in this determination. My AAC decision regulates the level of timber harvesting in the short term however it needs to consider timber supply implications throughout the full forecast horizon to avoid both excessive changes from decade to decade and significant timber shortages in the future.

In reviewing the potential for under- or over-estimating timber supply in the short term, I note that the main upward pressure on timber supply is due to a likely underestimation of timber volumes in existing stands. Although unquantified, the magnitude of this underestimation is expected to be at least 10 percent.

In the short term, the main source of potential overestimation of timber supply is an unquantified downward pressure due to uncertainties regarding old growth management areas with a maximum likely impact being no more than 5 percent. In addition, there is a 0.5 percent downward pressure due to isolated areas within the operable forest line that likely are uneconomic to harvest, a 0.3 percent impact due to the likelihood of some reserves on smaller S4 streams, and an unquantified effect due to assumptions about disturbances in stands outside the timber harvesting land base. In my view, the likely underestimation of volumes in existing stands should off-set the downward pressures on timber supply relative to what was assumed in the base case.

Mid-term effects on timber supply relative to the base case include the above short-term factors and also include unquantified potential volume losses from beetle-killed pine in mixed forests. Even with this added concern, the likely significant underestimation of volumes in existing stands should either off-set the cumulative downward pressures or at least help prevent a significant disruptive shortfall in timber supply in the mid-term.

I am also mindful of the expected phase 2 VRI results this fall 2005 that should provide more precision on the extent to which existing stand volumes have been underestimated. This information should reduce existing uncertainties in short- and mid-term timber supply that can be reflected in subsequent AAC determinations. In the meantime, using the best available information, I see no undue short- or mid-term risk to timber supply relative to the base case in my examination of upward and downward pressures.

In the long term, the main downward pressure on timber supply relative to the base case is anticipated losses due to Armillaria root rot that can have a significant effect on estimated regenerated stand volumes, an impact which I recognize could be in excess of 7 percent. Other downward pressures in the long term are reserves in small S4 streams (0.3 percent) and unquantified effects from assumptions made about natural disturbances outside the timber harvesting land base.

In the base case, the long-term timber supply is expected to increase 25 percent relative to the short- and mid-term. This substantial increase reflects the higher volumes forecasted in the timber supply analysis from second-growth managed stands and improvements in the genetic worth of seedlings planted after harvest. These projected increases in timber supply should help buffer the potential downward pressures and still allow for an increase in timber supply in the long term.

After carefully examining each of the relevant factors under Section 8 of the *Forest Act* for the Arrow TSA, the assumptions made in deriving the base case harvest projection in the timber supply analysis, and factors that may have over- or under-estimated timber supply in the short-, mid- and long-term, it is my determination that the current AAC of 550 000 cubic metres can be continued.

My AAC determination is predicated on contributions from the entire assumed timber harvesting land base, which includes eight operating areas within the Slocan Valley where operating performance can be a challenge given concerns such as local consumptive water use and visual resources. Avoidance of these operating areas could result in over-harvesting the remaining land base and/or cause potential mid-term effects on timber supply. I do not consider it necessary at this time to partition the harvest level for these operating areas in order to specify an amount of the total AAC that is expected from these areas. However, I do observe that it is necessary for harvest performance to occur in the operating areas at approximately the 25 000 cubic metre per year level that assumed in this determination.

The Defined Forest Area Management (DFAM) participants who were collectively responsible for this timber supply review deserve a great deal of credit for their efforts. I found the timber supply analysis to be very well done. The base case assumptions were well reasoned, and the sensitivity analyses provided the information I needed to assess the potential implications of uncertainties.

Considerable efforts were made in the timber supply review to obtain public and First Nations feedback regarding the timber supply analysis and data package yet very few comments were received. I understand this is occurring in other units as well. An assessment of why review comments are declining in this round of timber supply reviews,

at least for some units, needs to be undertaken to help ensure the processes for providing opportunities for pubic and First Nations comment are effective.

Determination

I have considered and reviewed all the factors as documented above, including the risks and uncertainties in the information provided. It is my determination that a timber harvest level that accommodates objectives for all forest resources during the next five years and that reflects current management practices as well as the socio-economic objectives of the Crown, can be best achieved in the TSA by establishing an AAC of 550 000 cubic metres.

This determination is effective July 1, 2005, and will remain in effect until a new AAC is determined, which must take place within five years of the effective date of this determination.

If additional significant new information is made available to me, or major changes occur in the management assumptions upon which I have predicated this decision, then I am prepared to revisit this determination sooner than the five years required by legislation.

Implementation

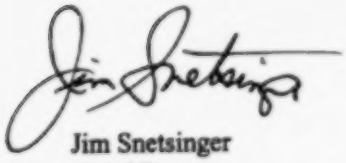
In the period following this decision and leading to the subsequent determination, I encourage BCFS staff and licensees to undertake the tasks and studies noted below that I have also mentioned in the appropriate sections of this rationale document. I recognize that the ability of staff and licensees to undertake these projects is dependent on available resources including funding. These projects are, however, important to help reduce the risk and uncertainty associated with key factors that affect the timber supply in the Arrow TSA.

- *Inoperable areas:* Some areas that were classified as operable with the current operability classification have been isolated due to previous harvesting thereby rendering them uneconomic. The reduction to the timber harvesting land base due to this isolation was roughly estimated to assist this determination. There is concern that additional isolated areas may be created by future forest development activities which could effectively further reduce the timber harvesting land base. There is a need to obtain a better estimate of these impacts and to monitor and minimize the creation of new isolated areas. There is also a need to monitor harvesting performance on both sides of the operability line so that the next determination can be based on a more reliable estimate of operability.
- *Site productivity estimates*: For the timber supply analysis, site productivity estimates for existing and future managed stands were based on Predictive Ecosystem Mapping (PEM) together with site index estimates for each biogeoclimatic site series (SIBEC). While the PEM for the Arrow TSA was accepted for use in the timber supply analysis, some qualifications were noted. Given the sensitivity of timber supply in the Arrow TSA to uncertainty in site index, it would useful to increase confidence in productivity estimates by monitoring growth of young stands using established protocols, and to improve the PEM classification, such as through

collection of additional data. These tasks should be considered by forest licensees under the Innovative Forest Practices Agreement as they are needed to reduce uncertainty in this factor in support of future AAC determinations.

- *Volume estimates for regenerated managed stands – Armillaria*: The potential impacts of Armillaria root rot on regenerated managed stands can be significant and a rough estimate of the impact indicates that the timber supply analysis may have significantly overestimated expected volumes in the long term. I encourage forest licensees to further refine estimated volume losses due to root rot so that these can be reflected in the next timber supply analysis.
- *Minimum harvestable ages*: Forest licensees and district staff are encouraged to work together and explore ways in which current uncertainties with respect to minimum harvestable ages can be reduced in support of subsequent determinations.
- *Scenic areas*: I have predicated my determination on harvesting performance in scenic areas and need to be confident that performance is occurring in scenic areas in approximate proportion to their contribution to projected timber supply. District staff and licensees need to work cooperatively to monitor performance in scenic areas due to the sensitivity of harvest flows to changes in the contributions from these areas. I will reconsider the level to which scenic areas will continue to contribute to the AAC in the next determination based on this monitoring information.
- *Community and domestic watersheds:* Monitoring harvesting performance in community and domestic watersheds is needed to ensure their relative contribution to delivering the AAC is appropriately achieved and also in assessing the timber supply analysis forest cover assumptions for these areas. This task should also be cooperatively undertaken by district staff and licensees as it will assist in verifying or improving modelling assumptions in support of the next determination. A substantial portion (47 percent) of the timber harvesting land base is in community and domestic watersheds so it is critical that modelling assumptions are substantiated or refined.
- *Wildlife tree patches:* The collection of operational information about future wildlife tree retention levels is needed to allow for a better accounting of this factor in future timber supply analysis.
- *Disturbance in stands outside the timber harvesting land base:* A more appropriate method needs to be developed by licensees to account for natural disturbances such as fire in stands outside the timber harvesting land base. This is important as these stands contribute to the achievement of forest cover requirements and thereby affect the timber supply availability of stands within the timber harvesting land base.
- *Slocan Valley:* District staff need to monitor performance in the eight operating areas so that this information can be factored into the next determination. The need for a partition can be examined at that time.
- *Unsalvaged losses*: Recent increased infestations of mountain pine beetle are likely resulting in increased unsalvaged losses than assumed in the base case. These losses are likely occurring in mixed stands with a minor component of pine since salvage

harvesting of most pine-leading stands is expected. For this determination, these additional losses are unquantified. There is a need to monitor these losses and try to quantify the impacts in support of the next determination. I encourage forest licensees and district staff to work together to better estimate unsalvaged losses due to bark beetles.



Jim Snetsinger
Chief Forester

June 9, 2005

Appendix 1: Section 8 of the *Forest Act*

Section 8 of the *Forest Act*, Revised Statutes of British Columbia 1996, reads as follows:

Allowable annual cut

8. (1) The chief forester must determine an allowable annual cut at least once every 5 years after the date of the last determination, for

(a) the Crown land in each timber supply area, excluding tree farm licence areas, community forest areas and woodlot licence areas, and
(b) each tree farm licence area.

(2) If the minister

(a) makes an order under section 7 (b) respecting a timber supply area, or
(b) amends or enters into a tree farm licence to accomplish the result set out under section 39 (1) (a) to (d),

the chief forester must make an allowable annual cut determination under subsection (1) for the timber supply area or tree farm licence area

(c) within 5 years after the order under paragraph (a) or the amendment or entering into under paragraph (b), and
(d) after the determination under paragraph (c), at least once every 5 years after the date of the last determination.

(3) If

(a) the allowable annual cut for the tree farm licence area is reduced under section 9 (3), and
(b) the chief forester subsequently determines, under subsection (1) of this section, the allowable annual cut for the tree farm licence area,

the chief forester must determine an allowable annual cut at least once every 5 years from the date the allowable annual cut under subsection (1) of this section is effective under section 9 (6).

(4) If the allowable annual cut for the tree farm licence area is reduced under section 9 (3), the chief forester is not required to make the determination under subsection (1) of this section at the times set out in subsection (1) or (2) (c) or (d), but must make that determination within one year after the chief forester determines that the holder is in compliance with section 9 (2).

(5) In determining an allowable annual cut under subsection (1) the chief forester may specify portions of the allowable annual cut attributable to

(a) different types of timber and terrain in different parts of Crown land within a timber supply area or tree farm licence area, and
(b) different types of timber and terrain in different parts of private land within a tree farm licence area.
(c) [Repealed 1999-10-1.]

(6) The regional manager or district manager must determine an allowable annual cut for each woodlot licence area, according to the licence.

(7) The regional manager or the regional manager's designate must determine a rate of timber harvesting for each community forest agreement area, in accordance with

(a) the community forest agreement, and
(b) any directions of the chief forester.

(8) In determining an allowable annual cut under subsection (1) the chief forester, despite anything to the contrary in an agreement listed in section 12, must consider

(a) the rate of timber production that may be sustained on the area, taking into account

(i) the composition of the forest and its expected rate of growth on the area,
(ii) the expected time that it will take the forest to become re-established on the area following denudation,
(iii) silviculture treatments to be applied to the area,
(iv) the standard of timber utilization and the allowance for decay, waste and breakage expected to be applied with respect to timber harvesting on the area,
(v) the constraints on the amount of timber produced from the area that reasonably can be expected by use of the area for purposes other than timber production, and
(vi) any other information that, in the chief forester's opinion, relates to the capability of the area to produce timber,

(b) the short and long term implications to British Columbia of alternative rates of timber harvesting from the area,

(c) [Repealed 2003-31-02.]

(d) the economic and social objectives of the government, as expressed by the minister, for the area, for the general region and for British Columbia, and

(e) abnormal infestations in and devastations of, and major salvage programs planned for, timber on the area.

1998-29-2;1999-10-1; 2000-6-2; 2002-25-21;

2003-30-01; 2003-31-02

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Appendix 2: Section 4 of the *Ministry of Forests Act*

Section 4 of the *Ministry of Forests Act* (consolidated 1988) reads as follows:

Purposes and functions of ministry

4. The purposes and functions of the ministry are, under the direction of the minister, to

(a) encourage maximum productivity of the forest and range resources in British Columbia;
(b) manage, protect and conserve the forest and range resources of the government, having regard to the immediate and long term economic and social benefits they may confer on British Columbia;
(c) plan the use of the forest and range resources of the government, so that the production of timber and forage, the harvesting of timber, the grazing of livestock and the realization of fisheries, wildlife, water, outdoor recreation and other natural resource values are co-ordinated and integrated, in consultation and co-operation with other ministries and agencies of the government and with the private sector;
(d) encourage a vigorous, efficient and world competitive timber processing industry in British Columbia; and
(e) assert the financial interest of the government in its forest and range resources in a systematic and equitable manner.

Documents attached:

Appendix 3: Minister of Forests' letter of July 28, 1994

Appendix 4: Minister of Forests' memo of February 26, 1996

Appendix 5: List of Public Submissions or Responses Received

File: 10100-01

JUL 28 1994

John Cuthbert
Chief Forester
Ministry of Forests
595 Pandora Avenue
Victoria, British Columbia
V8W 3E7

Dear John Cuthbert:

Re: Economic and Social Objectives of the Crown

The *Forest Act* gives you the clear responsibility for determining Allowable Annual Cuts, decisions with far-reaching implications for the province's economy. The *Forest Act* provides that you consider the social and economic objectives of the Crown, as expressed by me, in making these determinations. The purpose of this letter is to provide this information to you.

The social and economic objectives expressed below should be considered in conjunction with environmental considerations as reflected in the Forest Practices Code, which requires recognition and better protection of non-timber values such as biodiversity, wildlife and water quality.

The government's general social and economic objectives for the forest sector are made clear in the goals of the Forest Renewal Program. In relation to the Allowable Annual Cut determinations you must make, I would emphasize the particular importance the government attaches to the continued availability of good forest jobs and to the long-term stability of communities that rely on forests.

Through the Forest Renewal Plan, the government is taking the steps necessary to facilitate the transition to more value-based management in the forest and the forest sector. We feel that adjustment costs should be minimized wherever possible, and to this end, any decreases in allowable cut at this time should be no larger than are necessary to avoid compromising long-run sustainability.

.../2

Province of
British Columbia

Minister of
Forests

Parliament Buildings
Victoria, British Columbia
V8V 1X4

In addition to the provincial perspective, you should also consider important local social and economic objectives that may be derived from the public input on the Timber Supply Review discussion papers where these are consistent with the government's broader objectives.

Finally, I would note that improving economic conditions may make it possible to harvest timber which has typically not been used in the past. For example, use of wood from commercial thinnings and previously uneconomic areas may assist in maintaining harvests without violating forest practices constraints. I urge you to consider all available vehicles, such as partitioned cuts, which could provide the forest industry with the opportunity and incentive to demonstrate their ability to utilize such timber resources.

Yours truly,

Andrew Petter
Minister

Province of British Columbia
Ministry of Forests
OFFICE OF THE MINISTER

MEMORANDUM

File: 16290-01

February 26, 1996

To: Larry Pedersen
Chief Forester

From: The Honourable Andrew Petter
Minister of Forests

Re: The Crown's Economic And Social Objectives Regarding Visual Resources

Further to my letter of July 29, 1994, to your predecessor, wherein I expressed the economic and social objectives of the Crown in accordance with Section 7 of the *Forest Act*, I would like to elaborate upon these objectives as they relate to visual resources.

British Columbia's scenic landscapes are a part of its heritage and a resource base underlying much of its tourism industry. They also provide timber supplies that are of significant economic and social importance to forest industry dependent communities.

Accordingly, one of the Crown's objectives is to ensure an appropriate balance within timber supply areas and tree farm licence areas between protecting visual resources and minimizing the impact of such protection measures on timber supplies.

As you know, I have directed that the policy on management of scenic landscapes should be modified in light of the beneficial effects of the Forest Practices Code. In general, the new policy should ensure that establishment and administration of visual quality objectives is less restrictive on timber harvesting. This change is possible because alternative harvesting approaches as well as overall improvement in forest practices will result in reduced detrimental impacts on visually sensitive areas. Also, I anticipate that the Forest Practices Code will lead to a greater public awareness that forest harvesting is being conducted in a responsible, environmentally sound manner, and therefore to a decreased public reaction to its visible effects on the landscape. In relation to the Allowable Annual Cuts determinations that you make, please consider the effects that the new policy will have in each Timber Supply Area and Tree Farm Licence.

.../2

In keeping with my earlier letter, I would re-emphasize the Crown's objectives to ensure community stability and minimize adjustment costs as the forest sector moves to more value-based management. I believe that the appropriate balance between timber and visual resources will be achieved if decisions are made consistent with the ministry's February 1996 report *The Forest Practices Code: Timber Supply Analysis*.

Finally, in my previous letter I had asked that local economic and social objectives be considered. Please ensure that local views on the balance between timber and visual resources are taken into account within the context of government's broader objectives.

Andrew Petter
Minister of Forests

Appendix 5: List of Public Submissions or Responses Received

First Nations

Ktunaxa-Kinbasket Tribal Council*
Lower Similkameen Band*
Okanagan Band*
Okanagan Nation Alliance
Osoyoos Band
Penticton Band
Shuswap Nation Tribal Council
Spallumcheen Band*
Upper Similkameen Indian Band
Westbank First Nation

*contacted but no feedback received

Government agencies

Ministry of Forests

Non-government organizations

Friends of the Rossland Range
Kootenay Mountaineering Club

Academia

University of Northern British Columbia